This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

**Usage guidelines**

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.

+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.

+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.

+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

**About Google Book Search**

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`

THE FRANCIS A. COUNTWAY LIBRARY OF MEDICINE
HARVARD MEDICAL LIBRARY-BOSTON MEDICAL LIBRARY

# Surgery, Gynecology and Obstetrics

## An International Journal
Published Monthly


EDITORIAL STAFF

FOR AMERICA

John B. Murphy, M. D.
E Wyllys Andrews, M. D. J. Clarence Webster, M. D.

L. L. McArthur, M. D. E. C. Dudley, M. D. Frederic A. Besley, M. D.
A. J. Ochsner, M. D. C. S. Bacon, M. D. William R. Cubbins, M. D.
John Ridlon, M. D. Cecil v. Bachellé, M. D. John C. Hollister, M. D.
Thomas J. Watkins, M. D. Carl Beck, M. D. Rudolph W. Holmes, M. D

FOR THE BRITISH EMPIRE

A. W. Mayo-Robson, C. V. O., D. Sc., F. R. C. S., London
B. G. A. Moynihan, M. S., F. R. C. S., Leeds Thomas W. Eden, M. D., F. R. C. S., London
Harold J. Stiles, M. B., F. R. C. S., Edinburgh Henry Jellett, M. D., F. R. C. P. I., Dublin
James Rutherford Morison, M. B., F. R. C. S., Newcastle-on-Tyne

Franklin H. Martin, M. D., Managing Editor
Allen B. Kanavel, M. D., Associate Editor



Volume XVIII
January-June, 1914

PUBLISHED BY
THE SURGICAL PUBLISHING COMPANY OF CHICAGO
30 NORTH MICHIGAN AVENUE, CHICAGO
1914

# COLLABORATORS

## CHICAGO

Ex-Officio { CHARLES P. CALDWELL, M. D., President Chicago Medical Society
M. L. HARRIS, M. D., President Chicago Surgical Society
FRANK W. LYNCH, M. D., President Chicago Gynecological Society

W. H. Allport, M. D.
Frank T. Andrews, M. D.
James Burry, M. D.
Henry T. Byford, M. D.
Frank Cary, M. D.
Charles Davison, M. D.
Joseph B. DeLee, M. D.
E. J. Doering, M. D.
Frank B. Earle, M. D.
Jacob Frank, M. D.
Albert Goldspohn, M. D.
David W. Graham, M. D.
A. E. Halstead, M. D.
M. L. Harris, M. D.
Wm. M. Harsha, M. D.
J. C. Hoag, M. D.
Gustav Kolischer, M. D.
Henry F. Lewis, M. D.
Andrew McDermid, M. D.
John E. Owens, M. D.
C. E. Paddock, M. D.
S. C. Plummer, M. D.
John L. Porter, M. D.
C. B. Reed, M. D.
H. M. Richter, M. D.
E. C. Riebel, M. D.
Wm. E. Schroeder, M. D.
E. J. Senn, M. D.
D. A. K. Steele, M. D.
Weller Van Hook, M. D.
Bertha Van Hoosen, M. D.
Lucy Waite, M. D.

### NEW YORK

J. D. Emmet, M. D. Austin Flint, Jr., M. D.

### BOSTON

Walter L. Burrage, M. D. Edward Reynolds, M. D.

### PHILADELPHIA

E. E. Montgomery, M. D. John B. Deaver, M. D.
Edward P. Davis, M. D.

### BALTIMORE

Howard A. Kelly, M. D. J. C. Bloodgood, M. D.
J. Whitridge Williams, M. D.

### WASHINGTON

Henry D. Fry, M. D J. Wesley Bovée, M. D.

### ROCHESTER, MINN.

William J. Mayo, M. D. Charles H. Mayo, M. D.

### ST. LOUIS

N. B. Carson, M. D. Walter B. Dorsett, M. D.
M. G. Seelig, M. D.

### KANSAS CITY

A. A. Cordier, M. D. J. D. Griffith, M. D.

### LOUISVILLE

Lewis S. McMurtry, M. D. Ap. Morgan Vance, M. D.

### DENVER

W. W. Grant, M. D.

COPYRIGHT BY
THE SURGICAL PUBLISHING COMPANY
OF CHICAGO
1914

# CONTRIBUTORS TO VOLUME XVIII


ALBEE, FRED H. ..... 699
ANDERSON, W. J. ..... 522
BABCOCK, WAYNE ..... 119
BALFOUR, DONALD C. ..... 203
BARNEY, J. DELLINGER ..... 307
BARTLETT, WILLARD ..... 633, 761
BATES, U. C. ..... 753
BECK, EMIL G. ..... 754, 767
BECKMAN, E. H. ..... 551
BEEBE, S. P. ..... 438
BELL, W. BLAIR ..... 634
BENDIXEN, P. A. ..... 73
BERGTOLD, W. H. ..... 762
BESLEY, FREDERIC A. ..... 314
BIEHN, J. FAVEL ..... 258, 262
BINNIE, J. F. ..... 336
BIRNIE, JOHN M. ..... 632
BLAIR, VILRAY P. ..... 470, 640
BLOODGOOD, JOSEPH COLT ..... 19, 404
BLYTHING, J. D. ..... 73
BOORSTEIN, SAMUEL W. ..... 46
BREWER, GEORGE EMERSON ..... 145
BROUGHAM, E. J. ..... 637, 649
BROWN, JOHN YOUNG ..... 661
BRYAN, ROBERT C. ..... 545
CARTER, RALPH M. ..... 645
CARY, EUGENE ..... 730, 772
CASE, JAMES T. ..... 739, 767
CASTLE, O. L. ..... 477
CAULK, JOHN R. ..... 497
CLARK, JOHN G. ..... 10
CLAYBROOK, E. B. ..... 105
CODMAN, E. A. ..... 491
COERR, FREDERIC HUNTINGTON ..... 521
COLE, LEWIS GREGORY ..... 218
COLVIN, A. R. ..... 99
CORNER, EDRED M. ..... 508
CRILE, GEORGE W. ..... 429
CROTTI, ANDRE ..... 236
CURTIS, ARTHUR H. ..... 299, 392
CUTHBERTSON, WM. ..... 721, 774
DAVID, VERNON C. ..... 432
DAVIS, EDWARD P. ..... 116
DAVIS, LINCOLN ..... 676
DAVISON, CHARLES ..... 750, 772
DEAVER, JOHN B. ..... 294
DICKINSON, ROBERT L. ..... 559, 665
DUMM, WILLIAM M. ..... 444
DYAS, FREDERICK G. ..... 734, 770
EASTMAN, JOSEPH RILUS ..... 228
ECKE, A. C. ..... 637, 649
ELSBERG, CHARLES A. ..... 170
FINNEY, J. M. T. ..... 273
FORBES, A. MACKENZIE ..... 511
FORT, R. E. ..... 696
FOX, CHARLES M. ..... 243
FRIEDENWALD, JULIUS ..... 273
FULLERTON, WILLIAM D. ..... 451
FUNK, V. A. ..... 70
FURNISS, HENRY DAWSON ..... 584
GARDNER, JAMES A. ..... 84
GARRETT, NEVIL M. ..... 388
GEIGER, CHARLES ..... 763
GERAGHTY, J. T. ..... 196
GRANT, W. W. ..... 532
GREEN, FREDERICK R. ..... 611
HARPOLE, W. S. ..... 243
HART, HARRY H. ..... 120
HARTUNG, ADOLPH ..... 760, 771
HARTZ, H. J. ..... 502
HEINEBERG, ALFRED ..... 513
HILL, ROLAND ..... 616
HILL, W. H. P. ..... 318
HOFFMAN, FREDERICK L. ..... 726
HORSLEY, J. SHELTON ..... 536
JOHNSTON, GEORGE C. ..... 486
JUDD, E. S. ..... 289
KANAVEL, ALLEN B. ..... 484
KANE, HOWARD F. ..... 378
KEENE, FLOYD R. ..... 10
KELLY, HOWARD A. ..... 444
KERR, J. M. MUNRO ..... 621
KERR, NORMAN ..... 66
KEYES, JR., E. L. ..... 214
KRÖNIG, BERNHARD ..... 529, 653
LAMBERT, ADRIAN V. S. ..... 1
LANDON, L. H. ..... 95
LEONARD, V. N. ..... 35
LERCHE, WILHELM ..... 358
LEWIS, E. J. ..... 572, 649
LOWER, WILLIAM E. ..... 151
LYMAN, C. B. ..... 762
MACCARTY, WM. CARPENTER ..... 284
MACGOWAN, GRANVILLE ..... 329
MANN, ARTHUR T. ..... 326
MARSHALL, JR., E. K. ..... 196
MARTIN, WALTON ..... 719
MAYO, CHARLES H. ..... 322, 401
MCGLINN, JOHN A. ..... 180
MCGRATH, BERNARD FRANCIS ..... 376, 765
MCMURTRY, LOUIS S. ..... 556, 653
MCWILLIAMS, CLARENCE A. ..... 159
MOSCHCOWITZ, ALEXIS V. ..... 504
NICHOLSON, WILLIAM R. ..... 244
NORTON, WALTER A. ..... 103
PARK, ROSWELL ..... 340
PATERSON, HERBERT J. ..... 423
PETERKIN, G. SHEARMAN ..... 380
PFAHLER, GEORGE F. ..... 90
PHILLIPS, CHARLES E. ..... 233
PRESTON, M. E. ..... 260
ROWNTREE, L. G. ..... 196
RYERSON, EDWIN W. ..... 578, 649
SAMPSON, JOHN A. ..... 587
SCHMITZ, HENRY ..... 516
SEELIG, M. G. ..... 55
SHERMAN, HARRY M. ..... 62
SIMPSON, BURTON T. ..... 84
SISTRUNK, W. E. ..... 289
SKILLERN, JR., P. G. ..... 387
SKINNER, E. H. ..... 238
SMITH, RICHARD R. ..... 684
STANLEY, O. H. ..... 766
STARK, SIGMAR ..... 632
STEIN, IRVING F. ..... 547
STEWART, L. F. ..... 460
STRAUSS, ALFRED A. ..... 78, 122
STURGIS, MILTON G. ..... 456
SWEET, J. E. ..... 460
TARNOWSKY, GEORGE DE ..... 641
THOMAS, HENRY BASCOM ..... 580, 649
THOMAS, T. TURNER ..... 107
TOREK, FRANZ ..... 515
TULHOLSKE, LISTER ..... 55
VAN ALSTYNE, ELEANOR VAN NESS ..... 438
VAN HOOK, WELLER ..... 759
VON EBERTS, EDMOND ..... 318
WILDNER, FRANZ ..... 203

# SUBJECT INDEX TO VOLUME XVIII


ABDOMINAL, conditions, The diagnosis and surgical technique to be employed in the handling of acute, 661; incision, Technique of closing the, 378; retractor and wound protector, A new self-retaining, 753; operations, Pituitrin in intestinal paresis following, 766; wall, An artificial ureter made from the, 78; viscera, A new diagnostic sign in injuries of the, 105.
Abscess of the testicle, 307
Adenocarcinoma of the uterus, 392
Adenomata, The relation of multiple, to the etiology of enlargement of the prostate gland, 84
Adhesions, Amniotic membrane for the prevention of post-operative peritoneal, 762
American, College of Surgeons, 124; Medical Association, Education and publicity through the council on health and public instruction of the, 611
Amnion; hydramnios, Death of a full-term fœtus due to constriction of the umbilical cord by amniotic bands; rupture of, 730
Amniotic membrane for the prevention of post-operative peritoneal adhesions, 762
Amputations, An improved method of hæmostasis in shoulder and hip-joint, 103
Anuria, Calculous, with report of two cases, 676
Anæsthesia, in surgical research. A simple, economic and efficient apparatus for ordinary routine work, 765; in their cutaneous distribution, On the blocking of infra-orbital and mental nerves at their foramina to induce operative, 387
Anastomosis, of hollow viscera, A clamp intended to facilitate the suture, 761; of the ureter into the appendix, A note as to the recognition of the ureter; report of a case of, 119
Ankle and wrist, The mathematical calculation of prognosis in fractures at the, 238
Appendix, carcinoma of the, 262; A note as to the recognition of the ureter; report of a case of anastomosis of the ureter into the, 119
Arthritis, and its treatment, Clinical and experimental results of streptococcic infections with special reference to, 734; in the presence of chronic gonorrhœal infection in the female genitalia, The persistence of gonorrhœal, 265
Arthrotomy of the hip, 508
Artificial ureter made from the abdominal wall, 78
Aspiration-injection method, A simple apparatus for transfusion by the, 376
Autogenous intramedullary bone splints, Fixation of fractures by means of, 233

BACILLUS coli communis infection complicating pregnancy, The surgical treatment of, 116
Bacterin therapy, Some causes of failure in, 258
Bacteriological study of fifty cases of non-tuberculous diseases of the bladder and kidney, 432
Bile-duct, A rubber tube in the reconstruction of an obliterated, An hepaticoduodenostomy, 326
Birth fracture of the shaft of the femur, The treatment of a case of, 640
Bladder, Scalpel surgery of tumors of the, 380; Urinary incontinence in women without manifest injury to the, 444; and kidney, A bacteriological study of fifty cases of non-tuberculous diseases of the, 432
Blocking of infra-orbital and mental nerves at their foramina to induce operative anæsthesia in their cutaneous distribution, 387
Blood, Indirect transfusion of, 236; supply and uterine bleeding, The influence of ectopic pregnancy of the uterus, with special reference to changes in its, 587
Blood-vessel, injuries, The treatment of, 532; Surgical repair of, its technique, uses and limitations, 536
Bone, graft, Original surgical uses of the, 699; in Pott's disease, The transplantation of, 578; plates and bone screws, A preliminary report of the treatment of fractures by fixation with animal, 637; splints, Fixation of fractures by means of autogenous intramedullary, 233; splints, Treatment of fractures by medullary, 750; surgery, The electric drill, saw, reamer and trephine in, 763; transplant, 580; transplants, The function of the periosteum in, based on four human transplantations without periosteum and some animal experiments, 159; transplantation, Preliminary report of experimental work in, 572
Bones and joints, Syphilis of, with report of ten cases, 46
Border-line pathological lesions, Diagnosis and treatment of, 19
Bowel, Pneumatic rupture of the, 73
Breast, The treatment of recurrences and metastases from carcinoma of the, 90; End-results in operations for cancer of the, 289; Cancer of the, in a boy fifteen years old, 545; Clinical suggestions based upon a study of primary, secondary (carcinoma?), and tertiary or migratory (carcinoma) epithelial hyperplasia in the, 284

CÆSAREAN section, The extraperitoneal, 244
Calculous anuria; with report of two cases, 676
Cancer, of the breast, End-results in operations for, 289; of the breast in a boy fifteen years old, 545; statistics, The educational value of, to insurance companies, the public and the medical profession, 726; Resection of the rectum for, with preservation of the sphincter, 401
Carcinoma, A brief consideration of some recent tests for gastric, 645; of the appendix, 262; of the breast, The treatment of recurrences and metastases from, 90; of the intestine with chronic obstruction, 392; of the liver in childhood, Primary, 477; of the lower lip; its diagnosis and operative treatment, 404; Clinical suggestions based upon a study of primary, secondary (carcinoma?), and tertiary or migratory epithelial hyperplasia in the breast, 284
Carcinomatous urethra, Technique employed in excision of a, 632
Catgut, A simple heat method of sterilizing and storing, 633
Cervix, The post-operative results of trachelorrhaphy in comparison with those of amputation of the, 35
Chicago, Gynecological Society, 262, 392, 653, 772; Surgical Society, 122, 649, 767, 770 trans.
Childhood, Primary carcinoma of the liver in, 477
Cholecystectomy vs. cholecystostomy and a method of overcoming the special risks attending common-duct operations, 429
Cholecystitis, The rœntgenographic diagnosis of gall-stones and, 218
Chorionic villi, 264

Clamp intended to facilitate the suture-anastomosis of hollow viscera, 761
Clavicle, Excision of the, and first rib for malignant disease, 696
Closure in gastro-enterostomy, A preliminary report on a simple and rapid method of pyloric, 145
Coagulène-Kocher-Fonio, Personal experiences with; a critique of twenty cases in which the preparation was used, 641
Common-duct operations, Cholecystectomy vs. cholecystostomy and a method of overcoming the special risks attending, 429
Complications following surgical operations. A report of the complications in a series of 6,825 surgical operations performed in the Mayo Clinic in 1913, 551
Congenital, dislocation of the hip; a rational method of treatment, 62; pyloric stenosis, 616
Conservative surgery of the testicle, 329
Contracted pelves, Management of labor in cases with relatively, 388
Cranial surgery, Hæmostasis in, 95
Cysts of the omentum; with report of a case, 70

DENTAL disorders and peridental infections; their relation to neighboring organs, 470
Diagnosis and surgical technique to be employed in the handling of acute abdominal conditions, 661
Diagnostic sign in injuries of the abdominal viscera, A new, 105
Diaphragm, Eventration of the, with the report of a typical case with X-ray diagnosis, 547
Dilatation of œsophagus by operation, Treatment of diffuse, 1
Diseases and best method of treatment, Present status of joint, 754
Dislocation of the hip, Congenital; a rational method of treatment, 62; of the shoulder, Habitual or recurrent; a new axillary operation, 107
Displacements, An improved Gilliam operation for uterine, 721
Drill, saw, reamer and trephine in bone surgery, The electric, 763
Ductless glands, The relation of the, to the work of the surgeon, 340
Duodenal ulcer, The röntgen findings in gastric and, 739
Duodenum, Mobilization of the, 484

ECTOPIC pregnancy, with special reference to subsequent uterine and repeated ectopic pregnancies, Final results (after five years) in 192 patients operated upon for, 684; of the uterus, The influence of, with special reference to changes in its blood supply and uterine bleeding, 587
Education and publicity through the council on health and public instruction of the American Medical Association, 611
Efficiency engineering in pelvic surgery; one- and two-suture operations, 559
Electric drill, saw, reamer and trephine in bone surgery, 763
Elephantiasis congenitalis lymphangiectatica; with report of a case, 314
Endoscopy, Uterine, an aid to precision in the diagnosis of intra-uterine disease, 513
End-results in operations for cancer of the breast, 289
Epilepsy, The pituitary gland in relation to, 486
Epithelial hyperplasia in the breast, Clinical suggestions based upon a study of primary, secondary (carcinoma?), and tertiary or migratory (carcinoma), 284
Eventration of the diaphragm; with the report of a typical case with X-ray diagnosis, 547
Extraperitoneal cæsarean section, 244
Extravesically, Supernumerary ureter opening, 584

FASCIA, Free transplantation of, 318
Fat in surgery, Some uses of, 336
Femoral, hernia, The inguinal route operation for, with a supplementary note on Cooper's ligament, 55; neck, New appliance for the internal fixation of fractures of the, 260
Femur, The treatment of a case of birth fracture of the shaft of the, 640
Fibro-epithelial tumors of the lips, Composite or, 719
Fibroid tumors, of the ovaries, 451; of the uterus, The heart in, 180
Fibroma molluscum, Tumors of large nerves associated with, exhibition of largest specimen on record, 66
Fibula, Fracture of the lower ends of the tibia and, 99
Fields on the microscopic slide, Method of marking important, 120
Fœtal monstrosity, 393
Fœtus, Death of a full-term, due to constriction of the umbilical cord by amniotic bands; rupture of amnion; hydramnios, 730
Fracture, of the lower ends of the tibia and fibula, 99; of the shaft of the femur, The treatment of a case of birth, 640
Fractures, A double lever instrument devised for the open reduction of, 521; Treatment of, by medullary bone splints, 750; A preliminary report of the treatment of, by fixation with animal bone plates and bone screws, 637; of the femoral neck, New appliance for the internal fixation of, 260; at the ankle and wrist, The mathematical calculation of prognosis in, 238
Fulguration, Treatment of transplantable rat sarcoma by, 438
Functional tests in the surgical diseases of the kidney secondary to obstruction in the lower urinary tract, A study of the comparative value of, 196

GALL-STONES and cholecystitis, The röntgenographic diagnosis of, 218
Gastric, carcinoma, A brief consideration of some recent tests for, 645; and duodenal ulcer, The röntgen findings in, 739; hæmorrhage, 294; sarcoma, 502
Gastro-enterostomy, Jejunal ulcer following a, 773; A preliminary report of a simple and rapid method of pyloric closure in, 145
Gastrojejunostomy and the principles which should determine its use, The operation of, 423
Gastrostomy, Laryngectomy combined with, 515; Stamm's, corr., 527
Genitalia, The persistence of gonorrhœal arthritis in the presence of chronic gonorrhœal infection in the female, 265
Gilliam operation for uterine displacements, An improved, 721
Glands, The relation of the ductless, to the work of the surgeon, 340
Goiter question, A summing up of the, 322
Gonorrhœal arthritis in the presence of chronic gonorrhœal infection in the female genitalia, The persistence of, 265
Graft, Original surgical uses of the bone, 699
Gynecology, Massive X-raying in, 516
Gynecological diseases, The difference between the older and the newer treatments by X-ray and radium in, 529

HABITUAL or recurrent dislocation of the shoulder; eighteen shoulders operated in sixteen patients; a new axillary operation, 107

Hæmorrhage, Gastric, 294
Hæmostasis, in cranial surgery, 95; in shoulder and hip-joint amputations, An improved method of, 103
Head injuries; some conclusions, 522
Heart in fibroid tumors of the uterus, The, 180
Hepaticoduodenostomy, An; A rubber tube in the reconstruction of an obliterated bile-duct, 326
Hernia, The inguinal route operation for femoral, with a supplementary note on Cooper's ligament, 55
Herniæ of the linea alba, The pathogenesis and treatment of, 504
Hip, Arthrotomy of the, 508; Congenital dislocation of the, a rational method of treatment, 62; joint amputations, An improved method of hæmostasis in shoulder and, 103
Hospital, The product of a, 491
Hydramnios, Death of a full-term fœtus due to constriction of the umbilical cord by amniotic bands; rupture of amnion, 730
Hyperplasia in the breast, Clinical suggestions based upon a study of primary, secondary (carcinoma?), and tertiary or migratory (carcinoma) epithelial, 284
Hysteromyomectomy; Its evolution and perfection, 556

INCISION, Technique of closing the abdominal, 378
Incontinence, Urinary, in women without manifest injury to the bladder, 444
Incrustations of the renal pelvis and ureter, 497
Infection, of the kidneys, The ascending, 460; complicating pregnancy, The surgical treatment of bacillus coli communis, 116; Dental disorders and peridental, relation to neighboring organs, 470; Clinical and experimental results of streptococcic, with special reference to arthritis and its treatment, 734
Infra-orbital and mental nerves, On the blocking of, at their foramina to induce operative anæsthesia in their cutaneous distribution, 387
Inguinal route operation for femoral hernia; with a supplementary note on Cooper's ligament, 55
Injuries, Head, 522; of the abdominal viscera, A new diagnostic sign in, 105; Treatment of blood-vessel, 532
Intercarotid paraganglion and its tumors, 203
Internal fixation of fractures of the femoral neck, New appliance for the, 260
Intestinal paresis following abdominal operations, Pituitrin in, 766
Intestine, Carcinoma of the, with chronic obstruction, 392
Intramedullary, affections of the spinal cord, The surgical treatment of, 170; bone splints, Fixation of fractures by means of autogenous, 233
Intra-uterine disease, Uterine endoscopy; an aid to precision in the diagnosis of, 513

JOINT, diseases and best method of treatment, Present status of, 754; Syphilis of bones and, with report of ten cases, 46

KIDNEY, A bacteriological study of fifty cases of non-tuberculous diseases of the bladder and, 432; A study of the comparative value of functional tests in the surgical diseases of the, secondary to obstruction in the lower urinary tract, 196; The ascending infection of the, 460

LABOR, Management of, in cases with relatively contracted pelves, 388
Laryngectomy combined with gastrostomy, 515
Leucorrhœa, On the etiology and bacteriology of, 299
Lever instrument devised for the open reduction of fractures, A double, 521
Linea alba, The pathogenesis and treatment of herniæ of the, 504
Lip, Composite or fibro-epithelial tumors of the, 719; Carcinoma of the lower, Its diagnosis and operative treatment, 404
Liver, Primary carcinoma of the, in childhood, 477
Lymphangiectatica, Elephantiasis congenitalis, with report of case, 314

MALFORMATIONS of uterus and vagina, Operative treatment for, 621
Malignant disease, Excision of the clavicle and first rib for, 696
Marking important fields on the microscopic slide, Method of, 120
Massive X-raying in gynecology, 516
Mayo Clinic, Complications following surgical operations. A report of the complications in a series of 6,825 surgical operations performed in the year 1913, in the, 551
Medullary bone splints, Treatment of fractures by, 750
Membranes, A further study of pericolonic, 228; Amniotic, for the prevention of post-operative peritoneal adhesions, 762
Mental nerves, On the blocking of infra-orbital and, at their foramina to induce operative anæsthesia in their cutaneous distribution, 387
Metastases from carcinoma of the breast, The treatment of recurrences and, 90
Microscopic slide, Method of marking important fields on the, 120
Mixed-cell tumors of the soft palate, 456
Mobilization of the duodenum, 484
Monstrosity, Fœtal, 393

NECK, New appliance for the internal fixation of fractures of the femoral, 260
Neoplasms of the renal pelvis: with especial reference to transplantation in the ureter and bladder, 151
Nerves, Tumors of large, associated with fibroma molluscum; with exhibition of largest specimen on record, 66; On the blocking of infra-orbital and mental, at their foramina to induce operative anæsthesia in their cutaneous distribution, 387

OBSTRUCTION in the lower urinary tract, A study of the comparative value of functional tests in the surgical diseases of the kidney secondary to, 196
Œsophagus, Treatment of diffuse dilatation of the, by operation, 1
Omentum, Cysts of the, with report of a case, 70
Operations, Pituitrin in intestinal paresis following abdominal, 766
Ovary, Struma of the, 262
Ovaries, Fibroid tumors of the, 451
Ovarian teratomata, Cystic, 393

PALATE, Mixed-cell tumors of the soft, 456
Paraganglion, The intercarotid, and its tumors, 203
Paresis following abdominal operations, Pituitrin in intestinal, 766
Pathological lesions, Diagnosis and treatment of borderline, 19
Pelves, Management of labor in cases with relatively contracted, 388
Pelvic,organs, The relationship between the urinary system and diseases of the female, 10; surgery, Efficiency in, one- and two-suture operations, 559
Pelvis, Neoplasms of the renal, with especial reference to transplantation in the ureter and bladder, 151; and ureter, Incrustations of the renal. 497

Pericolonic membranes, A further study of, 228
Peridental infections, Dental disorders and, their relation to neighboring organs, 470
Periosteum in bone transplants, The function of the, based on four human transplantations without periosteum and some animal experiments, 159
Peritoneal adhesions, Amniotic membrane for the prevention of post-operative, 762
Pernicious anæmia treated by splenectomy, 243
Pituitary gland in relation to epilepsy, 486
Pituitrin in intestinal paresis following abdominal operations, 766
Pneumatic rupture of the bowel, 73
Post-operative results of trachelorrhaphy in comparison with those of amputation of the cervix, 35; peritoneal adhesions, Amniotic membrane for the prevention of, 762
Pott's disease, The transplantation of bone in, 578
Pregnancy, The surgical treatment of bacillus coli communis infection complicating, 116; of the uterus, The influence of ectopic, with special reference to changes in the blood supply and uterine bleeding, 587; Final results (after five years) in 192 patients operated upon for ectopic, with special reference to subsequent uterine and repeated ectopic pregnancies, 684
Product of a hospital, 491
Prostate gland, The relation of multiple adenomata to the etiology of enlargement of the, 84
Protector, A new self-retaining abdominal retractor and wound, 753
Publicity, Education and, through the council on health and public instruction of the American Medical Association, 611
Pyloric, canal, Spastic tumor of the, and other spastic conditions of the stomach; their surgical treatment, 358; closure in gastro-enterostomy. A preliminary report on a simple and rapid method of, 145; stenosis, Congenital, 616
Pyloroplasty, Thirteen years' experience with; A study of one hundred cases, 273

RADIUM in gynecological diseases, The difference between the older and the newer treatments by X-ray and, 529
Rat sarcoma, Treatment of transplantable, by fulguration, 438
Rectum, Resection of the, for cancer with preservation of the sphincter, 401
Recurrences and metastases from carcinoma of the breast, The treatment of, 90
Reduction of fractures, A double lever instrument devised for the open, 521
Renal, pelvis and ureter, Incrustations of the, 497; pelvis, Neoplasms of the, with especial reference to transplantation in the ureter and bladder, 151; tuberculosis, Concerning apparent cures of, 214
Repair of blood-vessels, Surgical, its technique, uses and limitations, 536
Research, Anæsthesia in surgical, A simple, economic and efficient apparatus for ordinary routine work, 765
Retractor, A new self-retaining abdominal, and wound protector, 753
Rib, Excision of the clavicle and first, for malignant disease, 696
Röntgen findings in gastric and duodenal ulcer, 739
Röntgenographic diagnosis of gall-stones and cholecystitis, 218
Rubber tube in the reconstruction of an obliterated bile-duct; An hepaticoduodenostomy, 326
Rupture of the bowel, Pneumatic, 73

SALPINGITIS in young women, A new operative procedure for the treatment of suppurative, 634
Sarcoma, Gastric, 502; Treatment of transplantable rat, by fulguration, 438
Scalpel surgery of tumors of the bladder, 380
Scoliosis, The treatment of, 511
Shoulder, and hip-joint amputations, An improved method of hæmostasis in, 103; Habitual or recurrent dislocation of the, eighteeen shoulders operated in sixteen patients, a new axillary operation, 107
Spastic tumor of the pyloric canal and other spastic conditions of the stomach; their surgical treatment, 358
Sphincter, Resection of the rectum for cancer with preservation of the, 401
Spinal cord, The surgical treatment of intramedullary affections of the, 170
Splenectomy, Case of pernicious anæmia treated by, 243
Stamm's gastrostomy, corr., 527
Stenosis, Congenital pyloric, 615
Sterilizing and storing catgut, A simple heat method of, 633
Stomach, X-ray findings in the normal, 757; Spastic tumor of the pyloric canal and other spastic conditions of the, their surgical treatment, 358
Streptococcic infections with special reference to arthritis and its treatment, Clinical and experimental results of, 734
Struma of the ovary, 262
Supernumerary ureter opening extravesically, 584
Surgery, Efficiency engineering in pelvic, one- and two-suture operations, 559
Suture, anastomosis of hollow viscera, A clamp intended to facilitate the, 761; operations, Efficiency engineering in pelvic surgery; one- and two-, 559
Syphilis of bones and joints; with report of ten cases, 46

TECHNIQUE to be employed in the handling of acute abdominal conditions, The diagnosis and surgical, 661
Testicle, Conservative surgery of the, 329; Abscess of the, 307
Tests, A study of the comparative value of functional, in the surgical diseases of the kidney secondary to obstruction in the lower urinary tract, 196; for gastric carcinoma, A brief consideration of some recent, 645
Tibia and fibula, Fracture of the lower ends of the, 99
Trachelorrhaphy, The post-operative results of, in comparison with those of amputation of the cervix, 35
Transactions, Chicago Gynecological Society, 262, 392, 653, 772; Chicago Surgical Society, 122, 649, 767, 770.
Transfusion, of blood, Indirect, 236; by the aspiration-injection method, A simple apparatus for, 376
Transplants, Bone, 580; The function of the periosteum in bone, based on four human transplantations without periosteum and some animal experiments, 159
Transplantation, of fascia, Free, 318; Preliminary report of experimental work in bone, 572; of bone in Pott's disease, 578; without periosteum and some animal experiments, The function of the periosteum in bone transplants, based on four human, 159
Treatment of recurrences and metastases from carcinoma of the breast, 90
Tuberculosis, Concerning apparent cures of renal, 214
Tumors, Spastic, of the pyloric canal and other spastic conditions of the stomach; their surgical treatment, 358; of the bladder, Scalpel surgery of, 380; of the ovaries, Fibroid, 451; of the soft palate, Mixed-cell, 456; of the lips, Composite or fibro-epithelial, 719; of large nerves associated with fibroma molluscum; with exhibition of largest specimen on record, 66; of the uterus, The heart in fibroid, 180; The intercarotid paraganglion and its, 203

ULCER, Jejunal, following a gastro-enterostomy, 773; The röntgen findings in gastric and duodenal, 739
Umbilical cord, Death of a full-term fœtus due to constriction of the, by amniotic bands; rupture of amnion; hydramnios, 730, 772
Ureter, Incrustations of the renal pelvis and, 497; A note as to the recognition of the, report of a case of anastomosis of the ureter into the appendix, 119; made from the abdominal wall, An artificial, 78; A method of exposing the pelvic portion of the, 632; opening extravesically, Supernumerary, 584
Urethra, Technique in excision of a carcinomatous, 632
Urinary, incontinence in women, without manifest injury to the bladder, 444; system and diseases of the female pelvic organs, The relationship between the, 10; tract, A study of the comparative value of functional tests in the surgical diseases of the kidney secondary to obstruction in the lower, 196
Uterine, bleeding. The influence of ectopic pregnancy of the uterus, with special reference to changes in its blood supply and, 587; endoscopy; an aid to precision in the diagnosis of intra-uterine disease, 513; displacements, An improved Gilliam operation for, 721; and repeated ectopic pregnancies, Final results (after five years) in 192 patients operated upon for ectopic pregnancy with special reference to subsequent, 684
Uterus, The heart in fibroid tumors of the, 180; Adenocarcinoma of the, 392; and vagina, Operative treatment for malformations of, 621

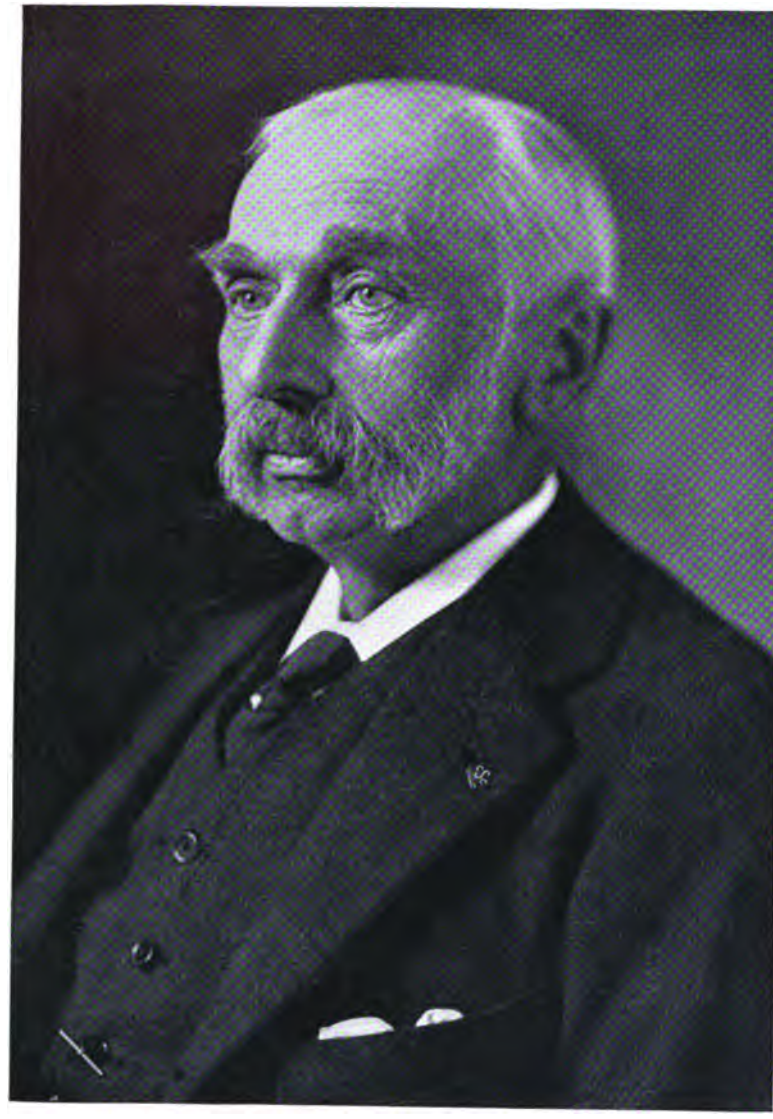
VAGINA, Operative treatment for malformations of uterus and, 521
Varicocele operations, 759
Villi, Chorionic, 264

WRIST, The mathematical calculation of prognosis in fractures at the ankle and, 238

X-RAY, and radium in gynecological diseases, The difference between the older and the newer treatments by, 529; findings in the normal stomach, 757
X-Raying in gynecology, 516

## INDEX TO BOOK REVIEWS

Abwehrfermente des Tierischen Organismus Gegen Körper, Blutplasma—und Zellfremde Stoffe, Von Emil Abderhalden, 400
Cheyne and Burghard's Surgical Treatment. Vol. V. Sir W. Watson Cheyne and F. F. Burghard, 397
Collected Papers by the Staff of St. Mary's Hospital, Mayo Clinic, 397
Der Chirurgische Operations Kursus. Von Victor Schmieden, 782
Der Infantilismus, Die Asthenie und Deren Beziehungen Zum Nervensystem. Paul Mathes, 269
Diagnosis of the Malignant Tumors of the Abdominal Viscera. Rudolph Schmidt, 525
Diseases of the Rectum and Anus. Harrison Cripps, 658
Diseases of the Rectum and Pelvic Colon. Martin L. Bodkin, 397
Diseases of the Stomach. George Roe Lockwood, 398
Diseases of Women. George Ernest Herman and R. Drummond Maxwell, 400
Electricity in Gynecology. May Cushman Rice, 269
Epidemic Cerebrospinal Meningitis. Abraham Sophian, 270
Fibroids of the Uterus; Their Pathology and Treatment. Sir John Bland-Sutton, 143
Genito-Urinary Diagnosis and Therapy. Ernst Portner, 144
Golden Rules of Surgery. Augustus Charles Bernays, 269
Gynecological Operations, Including Non-Operative Treatment and Minor Gynecology. Henri Hartmann, 398
Health Through a Rational Diet. Arnold Sorand, 269
Infection and Immunity. Charles E. Simon, 399
Infections of the Hand. Allen B. Kanavel, 660
Introduction à la Chirurgie Utérine Obstricale. A. Couvelaire, 398
Introduction to the History of Medicine, with Medical Chronology, Bibliographic Data, and Test Questions. Fielding H. Garrison, 660
Lehrbuch der Chirurgischen Operationen an der Hand. Fedor Krause and Emil Heyman, 659
Lehrbuch der Praktischen Chirurgie für Ärzte und Studierende. L. Gelpke and C. Schlatter, 400
Manual of X-Ray Technique. A. C. Christie, 400
Marriage and Genetics, Laws of Human Breeding and Applied Eugenics. Charles Reed, 399
Modern Hospital: Its Inspiration; Its Architecture; Its Equipment; Its Operation. John A. Hornsby and Richard E. Schmidt, 271
Modern Treatment of Nervous and Mental Diseases. William A. White and Smith Ely Jelliffe, 143
Muscle Spasm and Degeneration in Intrathoracic Inflammations and Light Touch Palpation. Francis Marion Pottenger, 272
Narcotic Drug Diseases and Allied Ailments. Geo. E. Pettey, 143
New Aspects of Diabetes. Pathology and Treatment. Carl von Noorden, 339
Pharmacology. Clinical and Experimental. Hans H. Meyer and R. Gottlieb, 784
Précis d'Anesthesie Locale. A. Piquand, 396
Précis de Radiologie Pratique. A. Lomon and C. Hahn, 782
Preventive Medicine and Hygiene. Milton J. Rosenau, 144
Principles of Surgery. W. A. Bryan, 658
Pye's Surgical Handicraft. Edited and Rewritten by W. H. Clayton-Greene, 398
Reproduction in the Human Female. James Young, 271
Surgery of the Stomach. Herbert J. Paterson, 396
Surgery of the Upper Abdomen. John B. Deaver and Astley Paston Cooper Ashhurst, 526
Surgery of Vascular System. Bertram M. Bernheim, 526
Surgical Clinics of John B. Murphy, 526, 783
Surgical Diseases and Injuries of the Genito-Urinary Organs. J. W. Thomson Walker, 783
Syphilis and the Nervous System. Max Nonne, 396
Textbook of General and Special Pathology for Students and Practitioners. Henry T. Brooks, 399
Treatment After Operation. William Turner, 397
Tuberculin in Diagnosis and Treatment. F. M. Pottenger, 397
Vaccine and Serum Therapy. Edwin Henry Schorer, 143
Vicious Circles in Disease. Jamieson B. Hurry, 271



Aikman G. Godlee

*President of the Royal College of Surgeons of England*

SURGERY, GYNECOLOGY AND OBSTETRICS

AN INTERNATIONAL MAGAZINE, PUBLISHED MONTHLY

VOLUME XVIII JANUARY, 1914 NUMBER 1

# TREATMENT OF DIFFUSE DILATATION OF ŒSOPHAGUS BY OPERATION

## DESCRIPTION OF A HITHERTO UNPUBLISHED METHOD. REPORT OF A CASE

BY ADRIAN V. S. LAMBERT, M. D., NEW YORK CITY
Associate Professor of Surgery, Columbia University

THE treatment of diffuse dilatation of the œsophagus has been directed toward the alleviation and removal of the supposed causative factor, which is now generally assumed to be a reflex spasm of the lower end of the œsophagus, or cardiac opening of the stomach, and commonly spoken of as cardiospasm.

This spasm was suggested as the etiological factor first by v. Mikulicz (1) in 1882, and was confirmed by Leichtenstern (2) in 1891 at the autopsy of a patient who had died but two hours previously. That it is not the sole etiological factor seems to be proven by the fact, as suggested by Rosenheim (3), that similar dilatations are only rarely met with as accompaniments of organic strictures, and he suggests as an additional element an inherent predisposition, such as a weakness of the œsophageal musculature.

In attempts to relieve this condition, dilatation of the cardiac opening has been the favorite mode of procedure, and in the majority of cases has proved efficient in relieving the symptoms. V. Mikulicz (4), in 1904, accomplished this by opening the stomach through a laparotomy wound and dilating the cardia by means of a clamp, the blades of which were protected by rubber tubing, which was passed through the cardia from below upward. Iden (5) recently reported a case in which a cure was effected by the same procedure. Later, v. Mikulicz (6) passed his fingers through the cardia and dilated with them in place of the clamp, as did Erdmann (7), following his example.

Several instruments have been devised by which dilatation may be accomplished without an open operation. Russell (8), in England, first reported success in these cases by this mode of treatment. The best known apparatus, however, are those devised and described by Gottstein (9) in Germany, and by Plummer (10) in America. The essential feature consists in a soft rubber dilatable bag or balloon, covered by silken mesh or material and fastened on to a bougie. This is passed from above downward through the cardia, and then, by distending the bag with water under regulated pressure, the cardia can be subjected to a dilating force of any degree desired.

This procedure takes into account and relieves but one element; namely, the spasm at the cardia. Recently a certain small proportion of failures and recurrences after this treatment have been reported. Since the œsophagus, which has become greatly dilated, in many cases does not regain its muscular tone and cannot return to its normal size and shape, it is not strange that the simple dilatation of the cardia fails to accomplish a permanent cure.

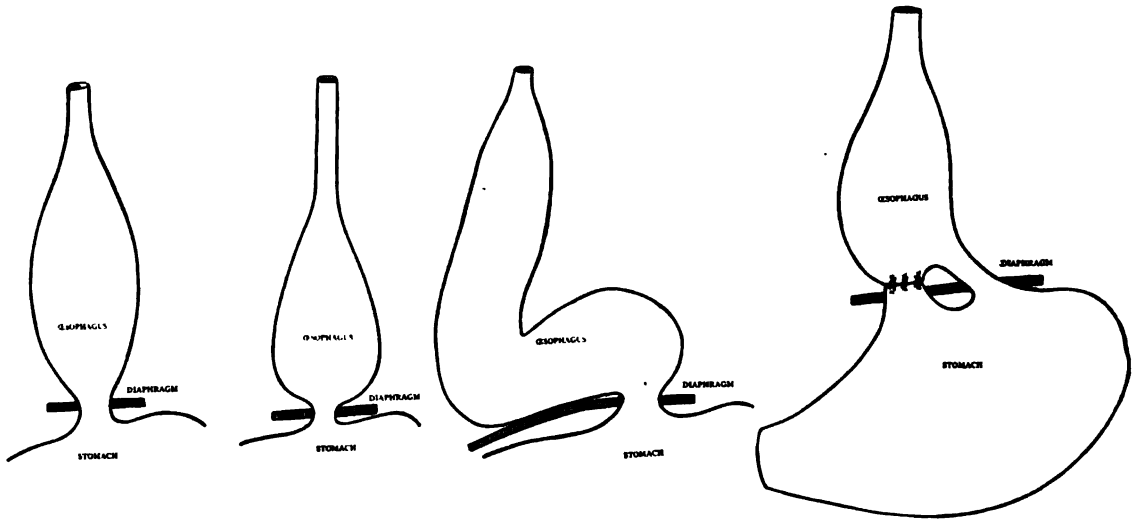



Fig. 1. Fig. 2. Fig. 3. Fig. 4.

Fig. 1. Fusiform dilatation of the œsophagus.
Fig. 2. Pear-shaped dilatation of the œsophagus.
Fig. 3. "ᔕ"-shaped dilatation of the œsophagus.

Fig. 4. Œsophago-gastrostomy. Portion of stomach drawn through an opening in the diaphragm, and the line of union between stomach and dilated œsophagus lies above the diaphragm, and within the thoracic cavity.

In a certain number of cases a very important element in the condition, namely, the form and character of the ectasia, must be considered, and the treatment must be directed to the relief of an anatomical arrangement which forms a mechanical hindrance to a cure by means of simple dilatation of the cardia.

Dilatation of the œsophagus may be fusiform, pear-shaped or "ᔕ"-shaped.

In the fusiform variety, which is most frequently met with, the cardia is the most dependent portion and there is no increase in the length of the œsophagus. The lumen of the œsophagus is increased from above downward to a point approximately midway between its upper end opposite the cricoid cartilage, and its lower end the cardia, and it then gradually diminishes in diameter until it passes through the diaphragm or enters the stomach (Fig. 1).

In the pear-shaped variety, the lumen attains its greatest degree of dilatation just prior to its passage through the diaphragm, and in this case also the cardia is the lowest and most dependent portion of the œsophagus (Fig. 2).

Both of these forms are relieved by simple dilatation of the cardia, although the walls of the œsophagus never return to normal, but remain hypertrophied, and the lumen never regains its normal caliber. The patients, however, continue free from symptoms for many years, as the œsophagus drains readily into the stomach through the dilated cardia and no stagnation of food or fluids results. Recently Plummer (11) states that the œsophagus does regain its shape and size and that its walls can, and often do, return to normal. This is contrary to the experience of most observers and writers.

The "ᔕ"-shaped variety is the rarest form and arises in the following manner: The upper end of the œsophagus opposite the cricoid cartilage, and its lower end at the cardia, being more or less firmly fixed points, the canal bends in those cases in which, as the dilatation of the œsophagus advances, there occurs also an increase in its length. This usually results in a curve toward the right; and the dilated œsophagus rests on the diaphragm to the right and posterior to the cardia, and from here it passes upward, forward and to the left, and enters the abdomen through the diaphragm at a higher level. There is thus developed a reservoir or

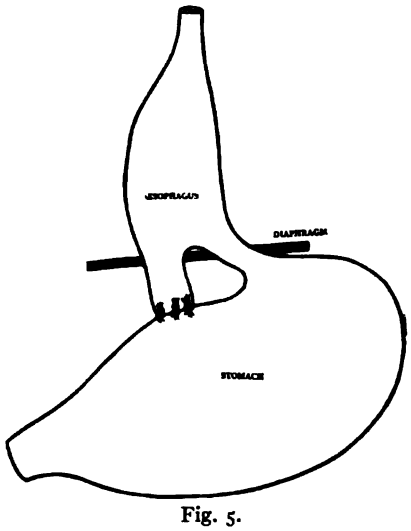



Fig. 5.

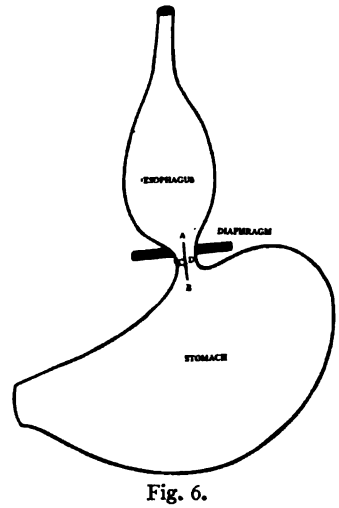



Fig. 6.

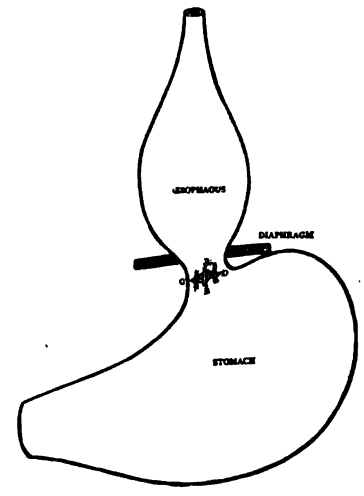



Fig. 7.

Fig. 5. Œsophago-gastrostomy. Portion of dilated œsophagus drawn through an opening in the diaphragm, and line of union between stomach and dilated œsophagus lies below the diaphragm, and within the peritoneal cavity.

Fig. 6. Cardioplasty showing line of incision A-B, which divides the constricted or spastically contracted cardia, in a line parallel to the long axis of the œsophagus.

Fig. 7. Cardioplasty showing the vertical incision united so that it lies transversely, in line C-D, to the long axis of the œsophagus. Note increase in lumen of cardia.

dead space, which is placed below the level of the cardia (Fig. 3). The stretching of the cardia will fail to remedy the mechanical difficulty which has developed in addition to, although as a result of, the cardiospasm. In fact, in some cases, the cardiospasm may have long since become inoperative.

With the purpose of removing the redundancy, Willy Meyer (12) in 1911 devised, and successfully performed, œsophagoplication. This is carried out by the transpleural route. The fibers of the vagus are stripped from the œsophagus, and by infolding the wall of the œsophagus the lumen is diminished. The procedure, however, would not in itself relieve the cardiospasm, although Meyer states that in his case the spasm was relieved and suggests that this resulted from the stripping of the fibers of the vagus from the œsophagus.

Œsophago-gastrostomy has been proposed and elaborate descriptions, based on work done on animals and the cadaver, have been written by Levy (13), Biondi (14), Janeway and Green (15), and Gosset (16).

This consists in establishing a communication between the dilated œsophagus and the stomach. This procedure was a brilliant conception, for although it would not relieve the spasm, still it would render it inoperative by diverting the food above the point of obstruction, and, at the same time, it would drain the dead space formed by the lengthened and dilated œsophagus. The line of union between the œsophagus and the stomach may be above or below the diaphragm, depending on whether one follows the transpleural or the transperitoneal route. In the former case a portion of the stomach is drawn up through an opening in the diaphragm and united to the œsophagus (Fig. 4). This procedure may be indicated in certain cases of cicatricial stricture in which the œsophagus is not dilated, or in cases of malignant disease in which a portion of the œsophagus must be removed; but is scarcely indicated in the "ω"-shaped form of diffuse dilatation, because a safer and equally efficient method is open to the surgeon. The same communication between the stomach and dilated œsophagus can be established from within the abdomen by drawing the œsophagus through an opening in the diaphragm (Fig. 5). This is a safer procedure because the line of anastomosis lies within the peritoneal cavity and in case of any leakage the infection is taken

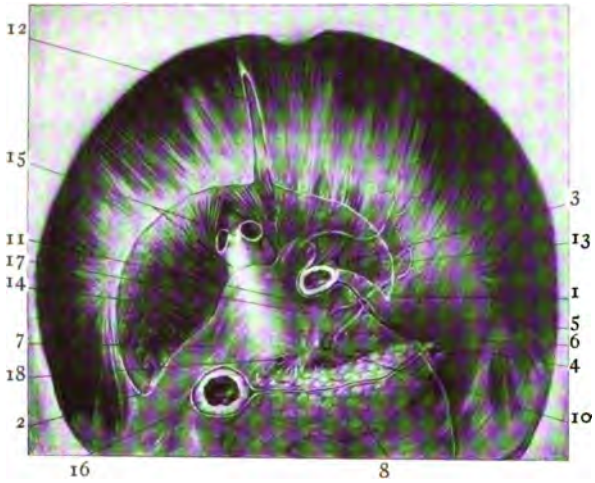



Fig. 8. Showing the relation of œsophagus to surrounding structures on under surface of diaphragm and posterior abdominal wall: 1, cut edge of left lateral ligament of liver on diaphragm; 2, cut edge of right lateral ligament of liver on diaphragm; 3, œsophagus divided; 4, splenic vessels divided and emerging from beneath tail of pancreas; 5, gastro-epiploica sinistra artery divided, lying in gastro-splenic omentum; 6, peritoneum of lesser sac covering structures on posterior abdominal wall; 7, posterior wall of foramen of Winslow; 8, pancreas covered by peritoneum of greater sac; 9, attachment on pancreas of transverse mesocolon; 10, gastric artery divided; 11, phrenic branch of aorta; 12, reflection of peritoneum divided, forming falciform ligament of liver; 13, non-peritoneal surface of diaphragm, formerly in contact with left lobe of liver; 14, non-peritoneal surface of diaphragm, formerly in contact with right lobe of liver; 15, inferior vena cava, with divided hepatic veins; 16, duodenum divided; 17, aorta; 18, hepatic artery divided.

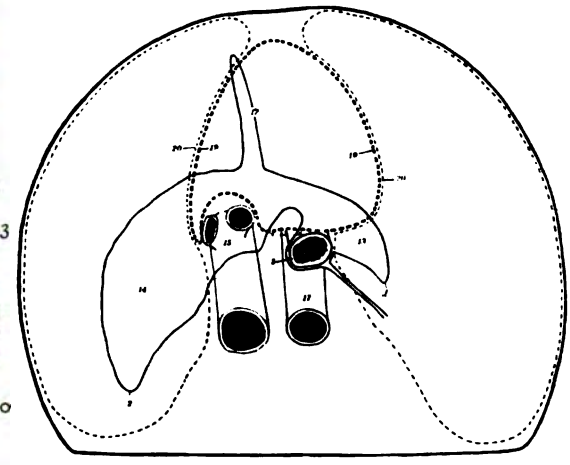


Fig. 9. Showing the relation to one another of the structures below and above the diaphragm: 1, cut edge of left lateral ligament of liver; 2, cut edge of right lateral ligament of liver; 3, œsophagus; 12, falciform ligament of liver; 13, non-peritoneal surface of diaphragm, formerly in relation to left lobe of liver; 14, non-peritoneal surface of diaphragm, formerly in relation to right lobe of liver; 15, vena cava inferior; 17, aorta; 19, line of reflection of pericardium; 20, line of reflection of right and left pleuræ; E–F, the area in diaphragm and the direction forward and to the right, where an incision may safely be made, in order to enlarge the opening in diaphragm through which œsophagus enters the abdomen.

care of better by the peritoneum than by the pleuræ or tissue of mediastinum.

Cardioplasty, which is analogous to pyloroplasty of Heinecke and v. Mikulicz, was suggested by Marwedel (17) and has been performed by Wendell (18). The operation consists in dividing the cardia by a vertical incision running parallel to the long axis of the œsophagus (Fig. 6), and then in uniting this incision in such a manner that the line of union lies transverse to the long axis of the œsophagus (Fig. 7). This procedure would accomplish nothing which could not be more safely brought about by a simple dilatation, as the operation would simply relieve the spasm, and would not drain the dependent portion in the "ᔕ"-shaped variety of dilation. The procedure described below will accomplish both of these objects.

As the region in which the operative procedure is carried on lies on the posterior abdominal wall, covered by the left lobe of the liver and protected from external violence by the overhanging lower limits of the thoracic cavity, formed by the lower ribs and the portion of the diaphragm attached thereto, and in consequence rendered just so much more inaccessible to operative interference, the question of the abdominal incision becomes an important one.

The abdominal incision which was employed was first made use of by v. Mikulicz (4) and has the advantage of not dividing the various nerves which supply the muscles of the abdominal wall, notably the upper portion of the rectus abdominis.

The incision commences at the ensiform cartilage and passes down to the umbilicus and then at a right angle to the tip of the tenth rib. In addition to this there is a second incision which is below the left breast over the eighth rib, and through this the seventh, eighth and ninth ribs are divided, without, however, injuring or opening the pleura.

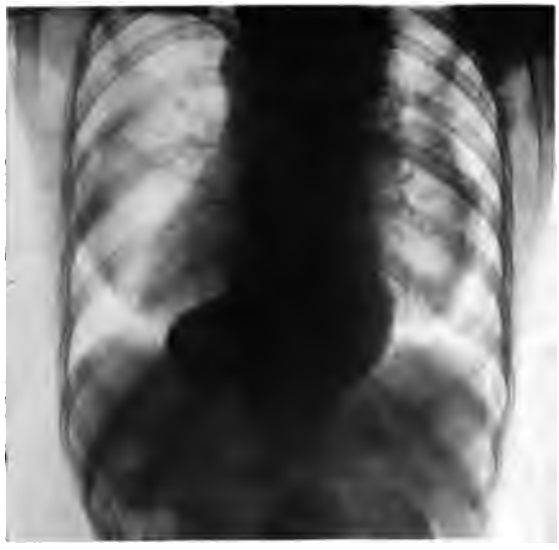


Fig. 10. X-ray antero-posterior view, before operation; showing the bend or "ω"-shaped curve of the lower portion of the dilated œsophagus. Note that there is no evidence that any of the bismuth meal has entered the stomach.

Fig. 11. X-ray, lateral view before operation; showing the reservoir or dead space which lies on a lower level than the dome of the diaphragm where the œsophagus enters the abdomen.

Although the fracture of the ribs seems like rather a formidable procedure, still it is warranted as it adds nothing to the danger of the operation, and allows of a much wider and more extended exposure by permitting the bending back of the abdominal flap and thus flattening out the diaphragm.

The incision proposed by Marwedel (20) and employed by most European writers, running parallel to the free border of the ribs, must divide the nerves from the sixth to the ninth and so interfere very materially with the innervation of the abdominal muscles and give rise to a resultant paralysis. It would also give a much more restricted exposure.

The relation of the œsophagus to surrounding structures is shown in Fig. 8, where it is seen that it lies anterior to the aorta and behind the left lobe of the liver, where the latter is attached to the diaphragm by the left lateral ligament. The peritoneum of the lesser sac is reflected on to the œsophagus posteriorly from the aorta, and on the right side from the diaphragm; on the left side the peritoneum of the greater sac is reflected in a similar manner from the left crus of the diaphragm where the two leaves of the gastro-splenic omentum meet on the œsophagus. Anteriorly the œsophagus is not in relation to any peritoneal fold.

In operations on the œsophagus from within the peritoneal cavity a very important feature of the anatomy of the œsophagus and the structures below the diaphragm is their relation to the structures lying above the diaphragm. These relations are shown in Fig. 9 where it is seen that the pericardium lies directly anterior to the œsophagus, while the left pleura is in close contact on the left side. There is, however, a considerable space on the right side before one encounters the inferior vena cava. It is in this space that one can safely incise the diaphragm. This is indicated in the diagram by the line E-F. Any incision to the left of the œsophagus will surely open the left pleural cavity as was inadvertently done in our case.

The following case, which occurred in the service of Dr. J. A. Blake at the Presbyterian Hospital, and through whose kindness I was

Fig. 12. Showing exposure of lower end of œsophagus after left lateral ligament of the liver has been divided and liver drawn downward and to the right: 1, cut edge of left lateral ligament of liver on diaphragm; 1a, cut edge of left lateral ligament of liver on liver; 3, lower end of œsophagus and cardia; 13, surface of diaphragm not covered by peritoneum; 14, surface of liver not covered by peritoneum; 21, re-entrant angle between liver and diaphragm.

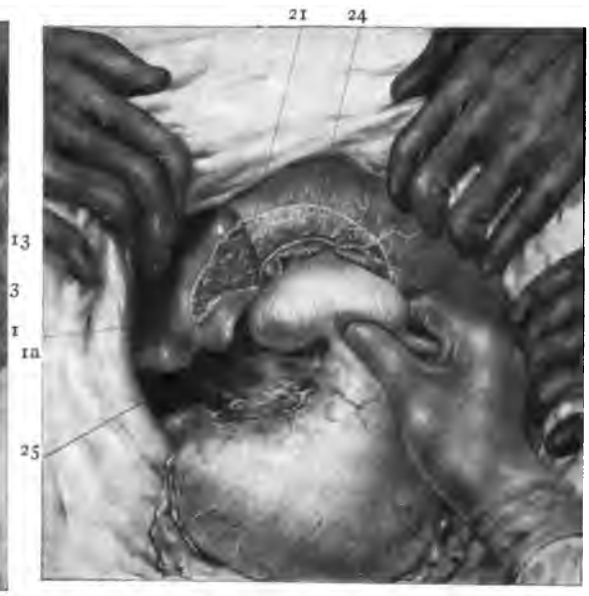



Fig. 13. Showing lower portion of dilated œsophagus (25) drawn down through opening in diaphragm (24); 1a, cut edge of left lateral ligament of liver on liver; 21, re-entrant angle between liver and diaphragm; 24, cut fibers of diaphragm to right of œsophagus; 25, dilated lower end of œsophagus.

able to operate, illustrates many of the foregoing facts, and presents also a new procedure, devised to relieve the spasm of the cardia if present, and to drain the dependent portion of the dilated œsophagus.

Case History: H. S., single, aged 40, Irish, cook; was admitted to Dr. Blake's service at the Presbyterian Hospital, May 6, 1912, with the following history: She was admitted to the medical division on April 10th, and stated that she had had "stomach trouble" for ten years. For the past five years she had had distress after eating and a feeling as though the food stuck in its passage to the stomach but this could be partly washed down with water. She vomited after every meal and this relieved her distress. The vomitus consisted of food she had just eaten. She never had any real pain. She gradually restricted her diet to cereals, eggs and milk, which gave her the least distress and trouble. About one year ago she noticed in the vomitus food taken twenty-four hours previously. She never vomited blood. She had been in the habit of tasting food at irregular intervals and had eaten at irregular intervals because of her occupation as cook.

After a test meal the contents expressed showed the following: Total amount, 190 cc. of thick gray fluid, containing a small amount of mucus; no free HCl; marked reaction for lactic acid, and many bacilli resembling Boas-Oppler bacilli. Her blood showed hæmoglobin 70 per cent; red blood cells, 5,300,000.

She was markedly emaciated; her physical examination at that time reported otherwise negative. A diagnosis of probable carcinoma of the stomach was made and she was transferred to a surgical ward and an exploratory cœliotomy performed. The findings were negative; the stomach was normal; there were a few small fibromyomata in uterus. The appendix was removed. She made a slow postoperative recovery. The wound healed per primum. She was quite unimproved by the operation and was sent back to the medical ward for further observation. May 1st, Dr. T. C. Janeway saw the patient for the first time. He passed a stomach tube and when about half its length had been swallowed a huge reservoir seemed to be tapped and several cubic centimeters of a thin watery fluid containing food particles were obtained. Water was passed through the tube and gurgling sounds were heard over the anterior chest wall, and there developed a dull percussion note. As much fluid as was possible was poured into the sac and then siphoned back. It measured 560 cc. Dr. Janeway thought that the tube did not enter the stomach, but a dilated œsophagus, or a diverticulum. The X-ray examination after a bismuth meal showed the condition which was present (Figs. 10 and 11). There is a diffuse dilatation of the œsophagus which has

Fig. 14. Showing clamp *in situ* including between its blades a portion of dilated œsophagus (25). Cardiac opening of stomach and a portion of stomach contiguous to cardiac opening (22). 1a, cut edge of left lateral ligament of liver on liver; 21, re-entrant angle between liver and diaphragm; 22, portion of stomach contiguous to cardiac opening; 23, line of union between stomach and œsophagus; 25, dilated lower end of œsophagus.

Fig. 15. X-ray lateral view 6 weeks post-operative, showing lumen of œsophagus still larger than normal. Note presence of portion of bismuth in the stomach.

also become lengthened and a pouch or dead space to the right of the cardia, resting on the diaphragm, can be readily distinguished, an "ᔕ"-shaped form of dilatation. There is no evidence of any of the bismuth having entered the stomach.

Dr. H. H. Janeway examined the interior of the œsophagus by means of his œsophagoscope. The cardia was readily made out and it was dilated by passing several graded bougies through it. There was no improvement after the passage of these bougies and the patient was transferred to Dr. Blake's service.

Operation. Dr. Lambert. Local anæsthesia, four per cent novocaine. A gastrostomy was performed through the upper third of left rectus under local anæsthesia. A Kader operation was done, inverting a funnel of gastric wall over a catheter by means of three purse-string sutures.

At this time the patient's general condition was poor, as she was reduced to a very low ebb, and the degree of emaciation was extreme. She made an uneventful post-operative recovery, and gained rapidly and steadily in weight. Her feedings by means of the gastrostomy gave her no discomfort, and the leakage from the opening was so slight that there was no irritation or ulceration of skin of abdominal wall in neighborhood of the fistula.

September 5th, four months after the gastrostomy, she had gained over 50 pounds and weighed 120 pounds. On two occasions, September 5th and 16th, the patient was given a string to swallow, with the hope that it would enter the stomach and so serve as a guide on which to pass some dilating apparatus. On each occasion, after 24 hours, the patient had a chill, felt nauseated, and had a rise of temperature to 102.5°, with a rise of pulse rate to 120. She would then vomit a large quantity of foul material, together with the string and would then feel perfectly well, while the temperature would drop to normal and remain so.

A string was passed from below into the œsophagus by means of a cystoscope, and was seized by Dr. H. H. Janeway through the œsophagoscope and drawn up through the mouth. By means of this string, using it as a guide, several graduated bougies were passed through the cardia, but with no beneficial results. No food passed into the stomach when taken by mouth. The cardia was then dilated by means of the Plummer apparatus. The dilator passed without difficulty but there was absolutely no improvement following repeated dilation.

Operation. Dr. Lambert, February 1, 1913. Patient was given ether and a cardioplasty was performed as follows: The peritoneal cavity was opened by a median incision which extended from the ensiform cartilage to the umbilicus. A second incision then extended to the left from the umbilicus

transversely to the tip of the tenth rib, in anterior axillary line. The seventh, eighth and ninth ribs were divided near the attachment of their cartilages through an incision beneath the left mammary gland. The pleural cavity was not entered. The stomach was then freed from the anterior abdominal wall by dissecting the gastrostomy free. This was then temporarily closed by a purse-string suture. The abdominal flap was then reflected upward, being hinged on the line of the ribs which had been divided. The left lateral ligament of the liver was divided and the liver was drawn downward and to the right while the stomach was pulled downward and to the left. This gave a perfect exposure of the cardiac opening of the stomach (Fig. 12). The diaphragm was then incised from the edge of the cardiac opening toward the right and slightly forward. The pleura was accidentally opened during this procedure as the incision was carried to the left of the œsophagus. This opening was immediately closed by a plain catgut suture. Through the hole in the diaphragm the lower end of the dilated œsophagus was freed from surrounding structures by blunt dissection with the index finger. A bougie passed down the œsophagus through the mouth was arrested in the extreme right portion of the dilatation. The end of the bougie and pouch of œsophagus were then drawn down through the opening in the diaphragm into the abdomen and the œsophagus was fixed in this position by interrupted plain catgut sutures, uniting it to the opening in the diaphragm. By this procedure there was established a straight tract from the pharynx to the opening through the diaphragm, and the redundant portion of the dilated œsophagus, which formed the reservoir for food and the dead space, was brought into the abdomen (Fig. 12). The purse-string suture closing the gastrostomy opening was divided and a long clamp was passed through the gastrostomy opening into the stomach. One blade of the clamp was then passed through the cardia into the dilated portion of the œsophagus, lying within the abdomen, while the other blade of the clamp remained within the stomach. The clamp was then closed sufficiently to hold firmly, but not to cut through the structures included between the blades, namely, a portion of dilated œsophagus and a portion of stomach including the cardiac opening, and the clamp became an œsophago-gastrotribe, similar in principle to the enterotribe (Fig. 14).

A row of Lembert sutures of chromic catgut united the contiguous portions of dilated œsophagus and stomach, a few interrupted sutures of chromic catgut united the diaphragm to the œsophagus. A catheter of soft rubber was placed in the stomach through the gastrostomy opening alongside of the handles of the clamp. The gastrostomy was then re-established by two purse-string sutures, Kader method, and attached to abdominal wall. A double rubber tube drain was placed down to site of line of union between stomach and œsophagus, and brought out of median wound; a second double rubber tube drain was placed between stomach and spleen and brought out at extreme left of incision. Abdominal wall closed, continuous plain catgut No. 1 for peritoneum; interrupted plain and chromic sutures for muscles and aponeuroses; silkworm gut, interrupted and continuous silk for the skin. The incision beneath the left breast was closed by interrupted silkworm-gut and continuous silk. Sterile dressing.

Fig. 16. X-ray, lateral view, four months post-operative, showing that lumen of œsophagus has still further contracted. Note presence of bismuth meal in stomach.

Time of operation, 2 hours and 20 minutes. Patient stood the manipulation and the operation fairly well, and showed only a moderate degree of shock. She lost only a small amount of blood during the entire procedure.

Post-operative course. The wounds healed with a moderate degree of reaction. There was considerable oozing from the drainage tubes, which was purulent and of a foul odor. This gradually cleared up. The clamps were allowed to remain undisturbed for four days when they were tightened to their full extent, crushing all structures included between them. They were removed on the ninth day post-operative.

There developed on the second day post-operative a dry pleurisy in the left pleural cavity, accompanied by a bronchitis with a thick, tenacious sputum. She experienced considerable difficulty in raising the expectoration and it caused her a great

deal of pain. These two conditions cleared up at the end of ten days. She received no nourishment for three days after operation, but small quantities of water through the gastrostomy. On the fourth day post-operative she was given liquid nourishment through the gastrostomy. The twenty-eighth day post-operative, she took liquids by mouth and solid food on the thirty-third day, when feeding by the gastrostomy was stopped.

During the first four weeks there was some bleeding from the site of anastomosis as evidenced by a marked reaction for blood in washings of dilated œsophagus. This gradually diminished and finally ceased. She was allowed out of bed on the thirty-fourth day. She regurgitated small amounts of food for several weeks but this has now ceased and the patient considers herself well, as she eats everything she desires and has neither any discomfort nor vomiting. She has gained enormously in weight.

X-ray taken six weeks after operation shows the bismuth meal has passed into the stomach. The lumen of the œsophagus is still larger than normal (Fig. 15). An X-ray taken four months after the operation shows that the lumen of the œsophagus has still further contracted, but has not yet returned to normal size (Fig. 16).

## CONCLUSIONS

1. There is a small number of cases of dilatation of the œsophagus, as a result of cardiospasm, which require operative interference in order to remain permanently cured.

2. This group comprises those cases in which the œsophagus has lengthened in addition to having become dilated and in consequence has the form of an "ſ"-shaped curve.

3. These cases may be successfully treated from within the abdomen, without fear of infection to the pleuræ or mediastinum.

4. A preliminary gastrostomy, through which the patient may gain nourishment, and so improve the nutrition and power of resistance, is an advantage.

## REFERENCES


1. v. MIKULICZ. Über Gastroskopie und Oesophagoskopie mit Demonstration am Lebenden. Verhandl. d. deutsch. Gesellsch. f. Chir., xi Cong., 1882, pp. 30–38.
2. LEICHTENSTERN. Beiträge zur Pathologie des Oesophagus. Deutsche med. Wchnschr., 1891, xvii, 489, 533.
3. ROSENHEIM. Ueber Spasmus und Atonie der Speiseröhre. Deutsche med. Wchnschr., 1899, xxv, 740.
4. v. MIKULICZ. Zur Pathologie und Therapie der Cardiospasmus. Deutsche med. Wchnschr., 1904, xxx, 17.
5. IDEN. Cardiospasm: report of a case, treatment by operation and subsequent dilatation. J. Am. M. Ass., 1911, lvi, 1438.
6. v. MIKULICZ. Loc. cit.
7. ERDMANN. Cardiospasm; with report of an operative case. Ann. Surg., Phila., 1906, xliii, 224.
8. RUSSELL. Diagnosis and treatment of spasmodic stricture of the œsophagus. Brit. M. J., 1898, 1450.
9. GOTTSTEIN. Weitere Fortschritte in der Therapie des chronischen Cardiospasmus (mit sackartiger Erweiterung der Speiseröhre.) Arch. f. klin. Chir., 1908, lxxxvii, 497.
10. PLUMMER. Cardiospasm; with report of 40 cases. J. Am. M. Ass., 1908, li, 549.
11. PLUMMER. Diffuse dilatation of the œsophagus without anatomic stenosis (cardiospasm). J. Am. M. Ass., 1912, lxviii, 2013.
12. MEYER. Impermeable cardiospasm successfully treated by thoracotomy and œsophagoplication. J. Am. M. Ass., 1911, lvi, 1437.
13. LEVY. Versuche über die Resection der Speiseröhre. Arch. f. klin. Chir., 1898, lvi, 839.
14. BIONDI. Esofago-gastrostomia sperimentale intratoracica. Suppl. al Policlin., Roma, 1895, i, 964.
15. JANEWAY AND GREEN. Cancer of the œsophagus and cardia: a description of an operation for its removal by transthoracic route under conditions of differential pressure. Ann. Surg., Phila., 1910, lii, 66.
16. GOSSET. De l'ésophago-gastrostomie transdiaphragmatique opération de Biondi. Rev. de Chir., 1903, xxviii, 694.
17. MARWEDEL. Die Aufklappung des Rippenbogens zur Erleichterung operative Eingriffe im Hypochondrium und im Zwerchfellkoppelraum. Zentralbl. f. Chir., 1903, p. 938.
18. WENDELL. Zur Chirurgie des Oesophagus. Arch. f. klin. Chir., 1910, xciii, 311.
19. GOTTSTEIN. Technik und Klinik der Oesophagoskopie. Mitt. a. d. Grenzgeb. d. Med. u. Chir., 1901, viii.
20. MARWEDEL. Loc. cit.

# THE RELATIONSHIP BETWEEN THE URINARY SYSTEM AND DISEASES OF THE FEMALE PELVIC ORGANS

By JOHN G. CLARK, M. D., and FLOYD E. KEENE, M. D., Philadelphia

SYMPTOMS referable to impaired bladder function play an important rôle in the clinical history of many pathologic conditions of the female pelvic organs. Its intimate anatomical relationship with the surrounding genitalia renders the bladder especially vulnerable to adjacent pathology, whether this be in the form of neoplasm, infection, or displacement. It is undoubtedly true that in the majority of such cases, the bladder is the only portion of the urinary tract affected, and with the removal of the primary cause the bladder symptoms will likewise be relieved. On the other hand, there is a second and by no means small group of cases in which the pathology of the urinary tract is more extensive, involving the ureter and kidney as well; or, disease of the urinary system may exist coincidentally with that of the genital tract, the one entirely independent of the other so far as etiology is concerned. The frequency with which an improper conception of the underlying pathology has prompted the correction of some minor gynecological abnormality when the actual lesion lies in the kidney or ureter opens up another possibility of error to the surgeon who limits his horizon to the pelvic organs or attempts to make his diagnosis from the interpretation of symptoms alone.

That the bladder should be a frequent participant in diseases of the genitalia, whatever their nature, is self-evident even to the most casual observer. Such interference is produced not only by distortion of the bladder walls through sacculation, pressure, or traction, which express themselves by symptoms of mechanical blockage to the passage of urine, but also by actual and often extensive changes in the muscular and mucous coats. These changes are due either to a superadded infection or impaired circulation, which affect chiefly the base of the bladder and are caused by partial obstruction of the venous or lymphatic current.

In view of the fact that evidence of some abnormality of the bladder is furnished by pronounced and definite complaints, we are prone to limit our explanation of the symptoms to this portion of the urinary tract, without considering the possibility of involvement of the ureters or kidneys. When we consider the anatomy of the ureters, it is only logical to assume that they must become involved in a certain proportion of cases, and that such an assumption is correct will be readily proven if this possibility is borne in mind and appropriate examinations made to determine it.

In their passage through the pelvis to the bladder, the ureters occupy a position which renders them liable to injury from disease of the pelvic viscera. That portion lying proximal to the parametrium is less frequently subjected to direct injury, but may be compressed by an impacted tumor, a dense inflammatory exudate, or glands which are the seat of metastatic carcinoma. The distal portions of the ureters as they pass through the parametrium, along the anterior vaginal wall and obliquely into the bladder, are brought into the most intimate contact with abnormalities of the uterus and vagina, and it is here that secondary involvement is most likely to occur.

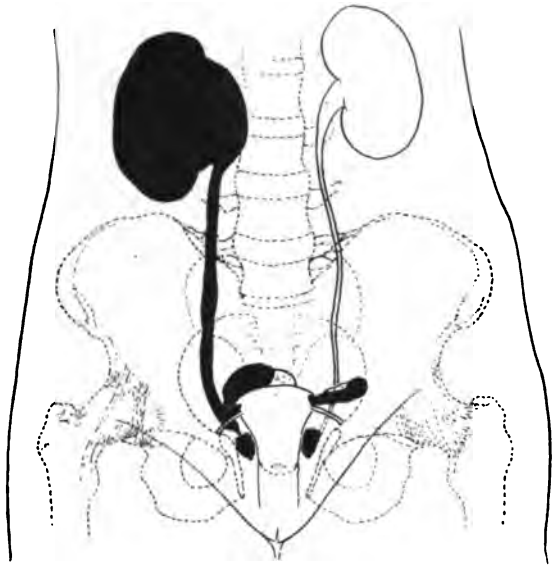
The end-results of ureteral involvement fall into two broad groups — the one of purely mechanical origin, expressed by dilatation of the ureter and renal pelvis, and the other due to infection. In the light of experimental as well as clinical evidence, infection of the ureter and pelvis of the kidney is usually a secondary manifestation; the primary factor which paves the way for the development of infection lies in a partial or a complete obstruction of the ureteral lumen, resulting in urinary stasis, dilatation of the ureter and pelvis with subsequent infection, which may be of hæmatogenous, lymphatic, or urogenous origin.

The possibility of ureteral compression in massive new growths, such as carcinoma of the cervix, and intraligamentary or impacted myomata, is commonly recognized; that such an occurrence may be associated with other and even more frequent anomalies is not sufficiently appreciated. Under normal conditions, the base of the bladder, especially the trigone, often presents an entirely different picture during the menstrual and intermenstrual periods; incident to the pelvic engorgement occurring immediately before and during menstruation, the muscularis and mucosa become acutely congested, swollen and œdematous. Clinical evidence of this fact is afforded by the frequency of minor vesical symptoms under normal conditions and the exacerbation of symptoms with cystitis during the menstrual flow. Given an abnormally small ureteral orifice, this recurrent swelling of the surrounding tissues may be sufficient to produce urinary stasis and subsequent dilatation of the ureter and pelvis of the kidney, as has been so ably pointed out by Mirabeau, who claims that he has encountered several cases of dysmenorrhœa arising from this cause. Further proof of this possibility is seen in cases of intermittent hydronephrosis in which the increase or onset of symptoms is often associated with menstruation.

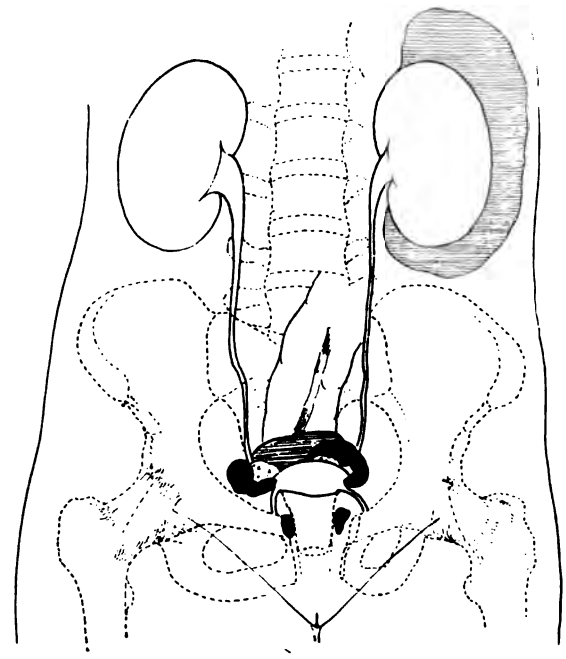
As a digression, but still a pertinent thought in this connection, we would suggest that this factor may play a part in explaining the frequency of right-sided pyelitis. In women, a freely movable right kidney is a frequent finding, and temporary retention of urine in the pelvis incident to partial obstruction of the distal portion of the ureter would, by its added weight, tend not only to hold the kidney in its lowest position, but also to exaggerate the angulation between the fixed and movable portions of the ureter, this in turn adding a second source of obstruction to be overcome. Under such circumstances, it seems logical to assume that a greater length of time would be consumed to relieve this retention than would be the case with the left kidney, which is situated high and is usually well fixed, affording free and immediate drainage with removal of the distal obstruction. Thus, as the result of repeated though transient retention, a gradual dilatation ensues, a more or less permanent urinary stasis results, and upon this, infection is engrafted. That dilatation of the pelvis and ureter is commonly associated with pyelo-ureteritis can be readily demonstrated by collargol injection and it has been looked upon as the result of inflammatory changes. According to our theory, the dilatation is primarily of purely mechanical origin, and may be secondarily exaggerated not only by swelling of the ureteral mucosa, which diminishes its lumen, but also by inflammatory changes in the walls of the renal pelvis and ureter which weaken their resistance to internal pressure.

Changes in the bladder, which may be seen in benign as well as malignant growths of the uterus, are so commonly recognized as to deserve but passing mention. Suffice it to say that as the result of distortion of the bladder walls, direct extension of a malignant growth, and impaired circulation due to pressure, these alterations may be of a sufficient degree to act as a contributory factor at least in the production of ureteral obstruction. Likewise, pelvic infection may exert its influence not only on the bladder but the ureters and kidneys as well; that infection of the parametrium has greater potential possibilities of secondary involvement of the upper urinary tract than that located within the peritoneum is self-evident, for in the former, the disease is in actual contact with the walls of the ureters. During the stage of active infection, pyelitis or pyelonephritis may result from direct extension up the ureter. That partial obstruction of the ureter is associated with an ascending infection is well demonstrated in the following case:

CASE 1. Age 25. Married six years. No children. Menstrual history normal. Leucorrhœa present, but not profuse. The present illness was of about five years' duration, beginning with frequent and painful urination. One year later she had "severe pain in the vagina," and her physician discovered an abscess, which was opened and drained. Shortly afterward he informed her that she had a "fistula in the vagina." There has been no incontinence of urine. Two years ago an abscess of the right Bartholin's gland necessitated evacuation. Burning pain along the urethra and frequency



Case 1. Extensive pelvic gonococcal infection; bilateral parametritis with stricture of the right ureter. Dilatation of ureter above stricture and pyonephrosis of gonococcal origin.



Case 2. Bilateral pyosalpinx with pelvic abscess; secondary perinephritic abscess; cultures from both showed colon bacillus infection.

of urination were the chief complaints on admission to the hospital. She has had several attacks of pain in the lower abdomen, but none recently. This pain was usually bilateral and lasted from two days to one week. She occasionally has experienced pain beneath the right costal border and in the lumbar region, which was independent of food or posture. Has never had hæmaturia, but the urine is constantly cloudy.

Abdominal examination: Tenderness over the lower abdomen. Distinct resistance in the upper right quadrant. The right kidney was somewhat enlarged, tender, and movable.

Vaginal examination: Induration of the right labium, which presented a small opening on its inner surface. Uterus in anteflexion. Both ovaries and tubes enlarged and adherent. Bilateral thickening of parametrium.

Urinalysis: Large amount of pus. No red blood cells. No tubercle bacilli were found either by smear or inoculation of guinea pigs.

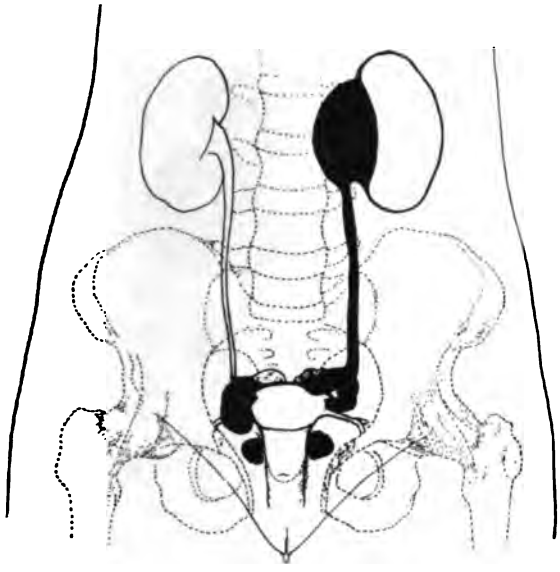
Cystoscopic examination: Urethral stricture of large caliber situated about one-half inch in front of internal sphincter. On passing a probe through the opening in right labium and a catheter into the urethra, the two met just behind the stricture. Bladder capacity, six ounces. On the right side of the bladder base, just external to the ureteral orifice, was an area of superficial ulceration. The orifice was small, thickened and reddened, and from it pus could be seen escaping. The left ureteral orifice was normal. Small superficial ulcerations were present in the base of the bladder. Indigo-carmine appeared from the left side normally in nine minutes; no excretion from the right in thirty minutes. Right ureter catheterized for a distance of six centimeters, where an impassable obstruction was met. Examination of the secretion from the right ureter showed pus, which contained only Gram negative, intracellular diplococci. Thirty-five cc. of a 10 per cent collargol solution were injected into the right ureter without discomfort. Skiagraph showed a greatly dilated ureter above the stricture as well as dilatation of the renal pelvis.

Diagnosis: Stricture of the urethra. Urethrovaginal fistula. Chronic parametritis and salpingo-öophoritis. Chronic ulcerative cystitis. Stricture of right ureter and pyelonephritis of gonorrhœal origin.

Patient still under observation.

In case the infection travels along the lymphatics, paranephritis may be the sequel.

CASE 2. Age 20. Single. Menstrual history normal. Seven months prior to admission, a vaginal puncture was performed for pelvis abscess of tubal origin. The present trouble began four weeks ago with acute pain low down in the left side of the abdomen. Shortly afterwards a mass was detected beneath the left costal border, which has gradually increased in size and is extremely tender, especially posteriorly. Chills and fever have developed, coming on usually at night. There has been no irritability of the bladder.



Case 3. Old pelvic inflammatory disease and parametritis with secondary partial obstruction of the lower portion of the ureter resulting in hydro-ureter and hydronephrosis.

Vaginal examination: Bilateral tenderness and infiltration of the parametrium.

Abdominal examination: Indistinctly fluctuating, tender mass in the left lumbar region.

Urinalysis: Normal.

Cystoscopic examination: Bladder normal. The left ureter was catheterized and the urine collected showed no pus.

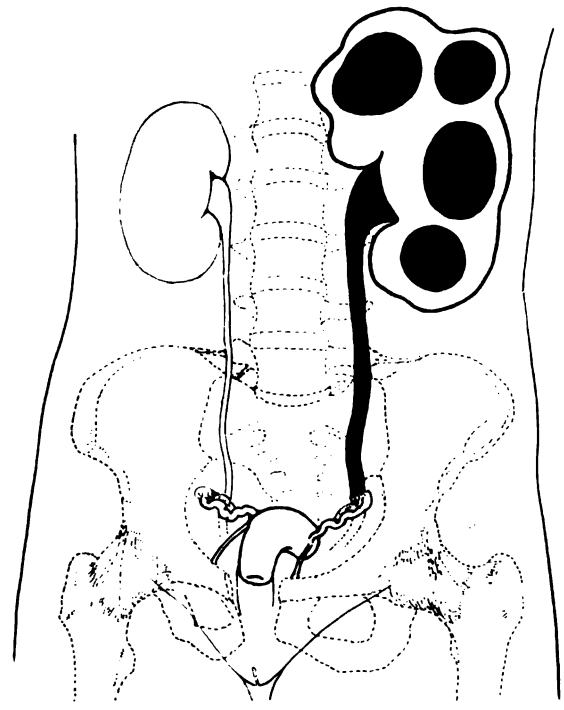
Diagnosis: Perinephritic abscess, secondary to pelvic infection.

Operation: Evacuation and drainage of perinephritic abscess.

Drainage removed in five days. The patient was discharged from the hospital cured in two weeks.

With subsidence of the acute process, the parametrium is transformed into dense, fibrous tissue, which by its contraction may compress the ureter and lead to the formation of hydronephrosis.

CASE 3. Age 31. Married. Six years ago the uterus and adnexa were removed on account of extensive inflammatory disease. The patient was sent to the hospital for the repair of a large incisional hernia and on account of intermittent pain supposedly due to intestinal adhesions. Two years after operation left-sided pain developed, which has been of a decidedly intermittent character with intervals of comparative comfort. The pain developed slowly, starting as a dull ache in the left lumbar region and increasing within a few hours to actual colic which required morphine for relief. The acute distress persists for ten or twelve hours



Case 4. Acute retroflexion of the uterus associated with vesicle symptoms due not to retroflexion but to left side tuberculous pyonephrosis.

and then gradually subsides. The pain extends downward into the pelvis and left thigh. Eating has no influence either in producing or relieving the pain; constipation seems to favor the development of these attacks. So far as she can remember, there is no increase in the amount of urine voided with subsidence of the attacks. There is frequency and urgency of urination, and once blood was noticed.

Vaginal examination: Infiltration in both vaginal fornices.

Abdominal examination: Large incisional hernia, otherwise negative. The left kidney is not palpable nor is there tenderness in the lumbar region.

Urinalysis: Normal.

Cystoscopic examination: Cystitis colli with papillary hypertrophy of the internal sphincter. The ureteral orifices present a normal appearance; the contractions on the right are more frequent than on the left. The left ureter was catheterized. Urine collected, normal. Sixty-three cc. of a 10 per cent collargol solution injected when the patient complained of a sensation of fullness in left kidney region. Skiagraph showed dilatation of the ureter and hydronephrosis.

Diagnosis: Incisional hernia. Left hydronephrosis and hydro-ureter.

Operation: Left nephrectomy. Repair of hernia. Operative recovery uneventful. In excellent health two years after operation.

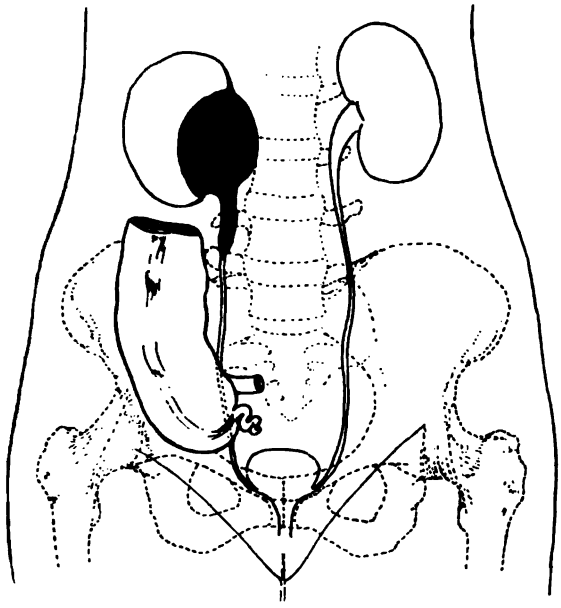
Case 5. Vesical irritability associated with a large myoma uteri and prominent cystocele; cystoscopic examination revealed tuberculosis of the left kidney.

In cases of extensive prolapsus uteri and cystocele, ideal conditions are presented for the development of complications on the part of the ureter and kidney. The possibility of such an occurrence was first called to our attention in studying the illustrations which Tandler and Halban present in their monograph on the topography of the ureter, where they show a marked dilatation of both ureters accompanying prolapse of the uterus. Under these conditions, there is not only a sacculation of the bladder, but an actual descensus of the trigone, a gliding, as it were, to the lowermost portion of the anterior cervical wall. The ureters must of necessity accompany this descensus and are, therefore, subjected to more or less torsion in their abnormal position. Pursuing this phase of the subject further, we find still other factors

Case 6. Hæmaturia associated with a large myoma uteri. Cystoscopic examination showed a primary carcinoma of the bladder.

which contribute not only to partial obstruction and dilatation of the ureters but also to their infection. Cystoscopic examination of the prolapsed bladder often shows, besides a low trigone, marked thickening of the mucosa and muscular wall and not infrequently extensive œdema bullosum; should infection supervene, these changes are exaggerated by those of a true cystitis. Under either condition, the ureteral orifices are surrounded by a swollen mucosa which offers some impediment to the normal flow of urine. Some degree of residual urine is a common accompaniment of an extensive cystocele and to this stagnation, infection may be added, so that the ureteral orifices are literally bathed in a pool of infected urine. Given, therefore, a partial obstruction of the terminal portions of the ureters, an extension of the infection to the pelvis of the kidney is extremely likely. We are confident that an associated pyelitis is responsible in some of those cases of vesical symptoms which persist even after operative correction of the prolapsus or cystocele.

In passing, we would say a word with regard to the influence of an uncomplicated



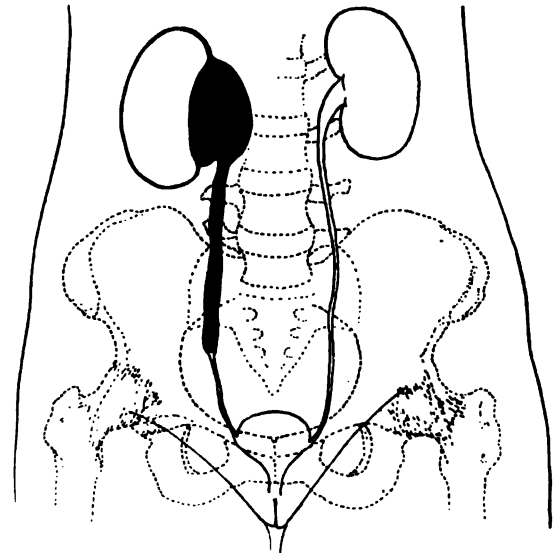
Case 7. Right-sided abdominal pain, supposed to be due to either appendicitis or cæcum mobile; further examination disclosed presence of dilated ureter and pelvis.

retroflexion in the production of vesical symptoms. A study of these cases has proven to us that the malposition, *per se*, rarely causes sufficient distortion of the bladder base to make itself manifest by urinary disturbances; given such a complication in the presence of a retroflexed uterus, it is a safe rule to assume that some other intra- or extravesical lesion is present and its exact nature must be determined by appropriate examinations. This is illustrated by the following case:

CASE 4. Age 20. Menstrual history normal. Six months prior to admission to hospital, the uterus was suspended for the relief of bladder symptoms. The present illness is of one year's duration, beginning with general weakness, loss of appetite and burning urination. The bladder symptoms have increased in severity until at present she has a constant desire to void, passing small quantities of cloudy, foul-smelling urine. She suffers from pain across the back, especially in the left lumbar region. There has been a rapid loss in weight and strength until now she is practically bed-ridden. For several weeks there has been irregular fever with chills and profuse sweats.

Vaginal examination: Uterus, tubes and ovaries, normal. Base of bladder thickened.

Abdominal examination: Large, tender and firmly fixed mass beneath the left costal border, extending backward, filling the lumbar region.



Case 8. Calculus impacted in the lower portion of the ureter giving symptoms suggesting appendicitis; calculus detected only after injection of collargol, which revealed marked dilatation of the ureter and renal pelvis.

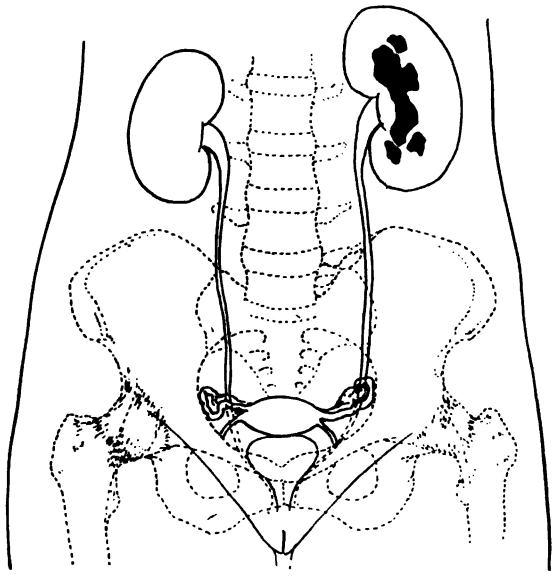
Cystoscopic examination: Bladder capacity reduced to less than three ounces. Diffuse ulcerative cystitis. The right ureteral orifice was normal; the left, transformed into a large crater with irregular, indurated and ulcerated edges. Indigo-carmin appeared from the right side in nine minutes as a dark blue stream. No excretion from the left.

Urinalysis: An abundance of pus and many red blood cells.

Diagnosis: Tuberculous pyonephrosis.

Operation: Tuberculous pyonephrosis with superadded colon bacillus infection. Nephrectomy impossible. Drainage. Sinus discharging freely eight months after operation. General health failing rapidly.

While it is essential to have in mind these lesions of the urinary tract which are of a purely secondary nature, the possibility of a primary disease of the kidney or bladder being a complication of the pelvic pathology is even more important so far as prognosis and treatment are concerned. The findings on pelvic examination may be sufficient to warrant the conclusion that the symptoms are explained solely by some pelvic lesion, while in reality this is of but minor importance. Routine use of the cystoscope in all cases presenting bladder symptoms will soon prove that such complications are by no means rare. Two cases prove the importance of this statement.



Case 9. On account of left-side pain, tubes and ovaries had been removed without relief; the actual lesion consisted of multiple calculi in the left kidney.

CASE 5. Age 49. Mother of five children. Previous medical history negative. According to the statement of her physician, a fibroid has been present for over twenty years but until a few years ago had not increased in size and has not been productive of symptoms. Recently, however, there has been an increase in the quantity of blood lost at the time of the periods, which last two or three days longer than formerly. Until three years ago, she had experienced no symptoms referable to the bladder aside from occasional incontinence of urine, which was controlled by a pessary; since then, there has been increasing frequency of urination with terminal pain. This is always increased when standing and relieved to some extent by the recumbent posture. Hæmaturia has never been present. There are no symptoms referable to disease of the abdominal organs.

Urinalysis: Numerous pus cells. Cultures of urine, sterile. Tubercle bacilli found in urinary sediment as well as by inoculation of guinea pigs. Skiagraph showed two indistinct, irregular shadows at the lower pole of the left kidney.

Vaginal examination: Extensive relaxation of the pelvic floor with large cystocele and rectocele; myoma uteri reaching over half-way to umbilicus.

Abdominal examination: Negative; the left kidney is not palpable nor is there lumbar tenderness.

Cystoscopic examination: Several superficial ulcerations at base of the bladder. The right ureteral orifice is normal; the left is transformed into a large, rigid, craterlike opening with ulcerated edges. Urine from right kidney normal.

Diagnosis: Cystocele and rectocele. Myoma uteri. Tuberculosis of the left kidney and ureter.

Operation: Anterior and posterior colporrhaphy. Supravaginal hysteromyomectomy. Left nephrectomy and partial ureterectomy.

Pulmonary embolus ten days after operation which retarded her convalescence. Otherwise there has been a steady improvement in her general health with almost complete relief of vesical symptoms.

CASE 6. Age 50. Single. For the past five years, the patient has suffered from a rheumatoid arthritis. Until three years ago, menstruation was normal; since then, the periods have gradually increased in duration as well as quantity, and at present they last over two weeks and at times large clots are passed. No bleeding between periods. About one year ago she noticed that the urine was of a dark red color and she was told by her physician that it contained blood. Since then, hæmaturia has been observed on frequent occasions with intervals during which the urine has been normal in color. Profuse hæmorrhage from the bladder has never been present; only rarely are clots passed, at which time she experiences considerable pain. Increased frequency of urination, as a rule without dysuria, has been a recent development.

Vaginal examination: Myoma reaching almost to umbilicus.

Cystoscopic examination: Primary carcinoma situated on the left side of the bladder, just external to the ureteral orifice.

Diagnosis: Myoma uteri. Primary carcinoma of bladder.

Operation: Supravaginal hysteromyomectomy; partial excision of bladder and implantation of left ureter.

A left-sided pyelitis developed on the tenth day after operation with acute symptoms lasting three days, otherwise the patient made a good operative recovery. Cystoscopic examination three months after operation shows no evidence of recurrence.

There remains another class of cases far too common in these days of accurate renal diagnosis, in which the appendix or ovaries are excised in the belief that they are the offending organs, when the only focus of disease lies in the kidney or ureter. Every surgeon has met such mistakes in the practice of others as well as his own, and when the final reckoning is taken, these errors are to be explained only on the ground of hasty conclusions based upon insufficient data to warrant a correct diagnosis. Differentiation between lesions of the urinary system and those of the appendix, gall-bladder, or ovary may be quite impossible from symptoms and physical findings alone; in these doubtful

cases, the modern methods of cystoscopic examination will rarely fail to prove or disprove the integrity of the kidney and ureter, while neglect of this procedure may result in failure to locate the cause of trouble and consequently in misdirected treatment. While numerous instances could be cited where one or more operations had been performed for some supposedly intra-abdominal lesion when in reality the kidney or ureter was at fault, we will present but three which have come to our notice recently.

CASE 7. Age 29. Married. Mother of two children. Menstruation regular, duration three to five days. Severe pain across lower abdomen during the first two days. The present condition dates from the birth of her second child, five years ago. She has suffered almost constantly from severe sacral backache as well as intermittent attacks of right-sided abdominal pain. Four years ago the appendix was removed and for a time she seemed better. During the past year these attacks have reappeared with increasing frequency and severity and she has been troubled with "indigestion" as expressed by epigastric pain, eructation of gas, and vomiting after eating. She has never vomited blood. No jaundice. As a general thing, the bowels are regular with occasional diarrhœa of one or two days' duration. The attacks of severe abdominal pain appear at irregular intervals and usually come on at night. They have no relation whatever to eating or the condition of the bowels. The point of most acute pain is located at the outer border of the right rectus on a level with the umbilicus. At times the colic is so severe that morphine does not give relief, and nausea and vomiting are often associated. With the attacks there are no bladder symptoms and the temperature remains normal. During prolonged rest in bed, the pain completely disappears, only to reappear when she is up and about. As the result of continuous suffering, she has become very nervous, with considerable loss in weight and strength.

Abdominal examination: Poor musculature and diastasis recti. Cæcum palpable and tender. Right kidney palpable. During an attack, exquisite tenderness extended from the right iliac fossa to the costal border, and was increased on deep inspiration. No enlargement of the kidney could be detected.

Vaginal examination: Negative.

Urinalysis: Negative.

Skiagraph of the kidney and ureter negative for calculus. The stomach was somewhat dilated and the colon ptosed, with large freely movable cæcum.

Cystoscopic examination was not made because the symptoms indicated gastro-intestinal rather than renal origin.

At a second operation a thorough examination was made of the abdominal organs and no abnormalities could be found. The right kidney was freely movable, but no enlargement could be detected. Flail-like cæcum suspended to lateral abdominal wall. Following the operation and until she resumed her regular activities, she was free from pain. It then returned and has exhibited the same characteristics as before operation. In order to determine the condition of the right kidney a cystoscopic examination was performed.

Bladder normal. Right kidney catheterized — 25 cc. of a 10 per cent collargol solution were injected. The skiagraph shows a marked dilatation of the renal pelvis and upper ureter with displacement of the kidney downward and inward.

Diagnosis: Nephroptosis with angulation of upper ureter and secondary intermittent hydronephrosis.

CASE 8. Single. Age 29. Menstrual history negative. Present illness: Two years ago she was seized with acute pain beneath the right costal margin which soon changed its position to the right iliac fossa. The pain was accompanied by nausea and vomiting and lasted for several hours until relieved by a hypodermic injection of morphine. For ten days following the subsidence of acute pain, tenderness remained in the right side of the abdomen. Four months later she had a similar seizure, and since then the attacks have been frequently repeated and usually come on with the menstrual period. Of late, the pain has been referred down the outer side of the thigh as far as the knee. She states that following the attacks pus and blood have been present in the urine. There has been no bladder irritability either with or between the attacks. Referred to hospital with diagnosis of appendicitis.

Vaginal examination: Negative.

Abdominal examination: Tenderness in the right iliac fossa as well as in the right costo-vertebral angle. No mass is palpable.

Urinalysis: Shows from 5 to 15 leucocytes to the field. No red blood cells and no casts.

Skiagraph: Negative for renal or ureteral calculus.

Cystoscopic examination: The vessels at the base of the bladder are somewhat congested but otherwise the mucosa is normal. The ureteral orifices present no abnormalities either in appearance or in character of their contractions. The right ureter was catheterized and an impassable obstruction was met 13 cm. from the ureteral orifice. At a second examination, a smaller catheter was passed, which met an obstruction at the same point as on the previous occasion. Twenty cc. of an 8 per cent collargol solution were injected; skiagraph showed catheter leading to a shadow in the ureter the size of a pea. Above this, the ureter as well as the renal pelvis was markedly dilated.

Diagnosis: Ureteral calculus.

Operation: Transperitoneal ureterolithotomy. Appendectomy.

Uncomplicated convalescence and in good health one year after operation.

CASE 9. Age 52. Mother of four children. Aside from present trouble, the patient has always been in good health. For about thirty-two years, she has had a dull aching pain in the left iliac region with only occasional sharp pains of short duration radiating into the vagina. Several years ago the tubes and ovaries were removed on the assumption that they were at fault, but the same pain has persisted. For a few weeks prior to admission to the hospital, there have been several mild attacks of pain in the left lumbar region; the pain shows no radiation, is unassociated with bladder disturbances and shows no relation to the taking of food, posture, or constipation. No symptoms referable to the abdominal organs.

Vaginal as well as abdominal examination negative; slight costovertebral tenderness on the left side.

Urinalysis: Many erythrocytes and pus cells.

Cystoscopic examination: The right ureteral orifice is normal; the left is small, œdematous and reddened. Indigo-carmin appeared on the right side as a faint blue discoloration in 25 minutes with no excretion from the left. Phthalein elimination (whole urine) during the first hour, 50 per cent; the second, 15 per cent. Both ureters catheterized; the urine flowed freely from the right kidney and was normal. From the left kidney, the secretion was greatly diminished and contained many erythrocytes and pus cells. The skiagraph showed multiple calculi in the left kidney.

Diagnosis: Multiple calculi in left kidney.

Operation: Left nephrectomy. Only a shell of renal parenchyma remained.

Patient made an uneventful recovery. It is interesting to note that the phthalein elimination was the same after operation as before.

Realizing that lesions of the urinary system may occur either as complications or sequelæ of disease of the female pelvic organs, we cannot urge too strongly the importance of determining their exact nature before resorting to an operation, which otherwise may be inadequate or even unnecessary. Experience in a large number of these cases has taught us that the solution of this problem cannot be gained from dependence upon symptoms; they can only serve as an indicator which points to the necessity of further investigations. Whether we are dealing with primary disease of the kidney or abnormalities of the pelvic organs which encroach upon the bladder, the subjective manifestations common to both are often limited to vesical symptoms. The relationship of the one to the other can be definitely determined only by a thorough examination of the bladder, ureter, and kidneys. A routine cystoscopic examination in all cases presenting vesical disturbances, irrespective of the coincident pelvic pathology, should be the rule, for only by following this precaution can grave errors in diagnosis be avoided.

# DIAGNOSIS AND TREATMENT OF BORDER-LINE PATHOLOGICAL LESIONS[1]

By JOSEPH COLT BLOODGOOD, M. D., Baltimore, Maryland

A BORDER-LINE pathological lesion may be defined as one in which it is difficult to differentiate whether it is benign or malignant, either from the clinical history and examination, or from the gross appearance, or from the microscopic section.

In some cases this differential diagnosis is not essential for treatment, because the entire lesion can be radically removed without danger or mutilation.

In many instances, however, the differential diagnosis between the benign and malignant leads to an operative removal essentially different, and when this diagnosis is made, the patient is insured the best chances of a cure if the lesion be malignant, and the least mutilation if it be benign.

The development of the diagnosis of border-line pathological lesions will keep pace with the number of patients who seek advice in that early period of the disease in which this diagnosis is difficult.

It has only been in recent years that the number of these border-line pathological lesions has increased. That it has increased during the period of greatest development in clinical, gross and microscopic diagnosis, is evidence that patients are seeking advice with lesions in an earlier stage, and these lesions, clinically and pathologically, are presenting different pictures.

In the past two years I have seen more border-line breast lesions than in the previous twenty.

In the past few years, also, surgeons have been investigating with much greater accuracy and on a larger scale their ultimate results after operations for malignant disease. The following facts have made a great impression on them.

In every group of malignant tumors there is a large number, often as much as fifty per cent, who come for surgical help after the malignant disease has extended beyond operable removal. Now, in these cases, except in a few instances of internal cancer, there is no difficulty in making the diagnosis clinically, in the gross, or from a microscopic section.

These patients are doomed. As yet we have found nothing for their help. Granting a few cures with X-rays, radium or serum, the number uncured is sufficiently great to be impressive. All of these patients have delayed treatment from ignorance or fear. In every case there had been opportunity for operative relief at a much earlier period.

In another group, as a rule the largest, a diagnosis of malignancy could be made clinically, and the diagnosis confirmed from the gross and microscopic study. In this group, and on account of this diagnosis, the disease has been operated on with every evidence at the operation that the lesion was completely removed. Nevertheless, the number of cures is relatively small — on the average in about twenty-five per cent of the cases.

It is quite true that in some localizations benign lesions may assume all the clinical appearances of the malignant. Yet the number of such cases is so small, and the harm from treating them as malignant upon the clinical diagnosis is so slight, if any, that they need not be considered, except in their exclusion as cured cases of malignant disease in the study of the ultimate results.

In the next group, which in the past has been a small one, but fortunately is increasing, the patients come under observation with

Note.—This contribution will be followed by a series of articles to be published in this journal. These articles will discuss the problem of the early recognition and appropriate treatment of the different lesions in certain definite localizations. The next article will consider lesions of the lower lip; the third, lesions of the tongue and floor of the mouth; the fourth, lesions of the mucous membrane of the gum and cheek.

[1] Read before the American Surgical Association, Washington, D. C., May 8, 1913.

lesions in such an early stage that none of the clinical evidence which in the past we have associated with malignant disease is present. From all clinical evidence the lesion is benign. Nevertheless in the past we have met such cases and at the exploratory operation have found malignant disease.

Up until a few years ago the percentage of cases of cancer of the breast seeking advice when the lesion was still clinically benign was about ten. In the past two years the number of cases has reached almost twenty per cent.

As I stated before, the number of benign lesions which may come under observation with all the clinical appearances of the malignant is relatively small, while the number of malignant lesions which may come for surgical treatment before a clinical diagnosis by the ordinary clinical methods is possible, although relatively small, is very much larger than the previous group, and, due to the education of the public and the profession, is getting larger daily.

The mental attitude of the surgeon to-day toward mistakes in diagnosis must be changed. In the past, for reasons I am unable to ascertain, the surgeon seems to have feared most the performance of radical operation upon lesions clinically malignant, but pathologically benign. In this group the only disadvantage is mutilation. The number of cases could never have been large. Perhaps the fear was due to the fact that in the past the number of cures after operation for malignancy in this stage was so small that every surgeon fought against such extensive operations without the justification of certainty in diagnosis. On the other hand, when malignant disease has come under his care in an early stage in which a clinical diagnosis could not be made, and the surgeon removed the disease as if it were benign and then later found from pathological examination that it was malignant and should have been treated more radically, he, the surgeon, has not felt chagrined, nor felt that he has made anything more than a justifiable mistake. In many instances he has attempted to correct this by immediate secondary and more radical operation. The majority of surgeons do not know the danger of this procedure.

My investigation of a large number of cases shows that the radical operation performed upon a malignant lesion, clinically benign, gives far better ultimate results than an identical operation upon the same lesion at a later period when it is clinically malignant, provided the operation in the earlier stage is performed in one stage. In this group the diagnosis of the lesion should be made at an exploratory incision from the gross appearance with or without the aid of a frozen section. The exploratory incision is cauterized, and the radical operation follows immediately.

In breast lesions the number of cases is so large that we can work out statistics pretty accurately, and these are as follows:

The probability of a cure when the breast cancer is clinically malignant and operable is about twenty-five per cent, while if the breast cancer is clinically benign and the radical operation follows immediately the exploratory incision, the probability of a cure is eighty per cent. However, if the malignant lump only is removed and then, later, days or weeks after the microscopic diagnosis is made, the complete operation is performed, the probability of a cure is less than ten per cent.[1]

In all malignant lesions, in practically every localization, the evidence of the ultimate results supports these conclusions.

The best opportunity for a cure is after radical operation in that early stage of the

[1] NOTE (December, 1913).—Since this article was written the results in cancer of the breast have been computed up until 1913. In 1908 the percentage of five-year cures of cancer of the breast was 35, in 1913 this has increased to 42. This improvement is due to the increase in the number of early cases rather than improvement in the surgery.

The difference between the results in operations upon early cases, where the lump is still clinically benign, in which the diagnosis was made at the exploratory incision and followed at once by the complete Halsted operation, is shown in the following figures:

In adenocarcinoma of the breast there are 15 early clinically benign cases, in which five years or more have elapsed since operation; all are cured, 100 per cent. The results in later clinically malignant cases are 64 per cent. In this group there has been but one local recurrence.

In the more malignant cancers of the breast — medullary and scirrhous — the percentage of cures in the clinically benign cases is 85, of the clinically malignant 33 per cent. These figures are, of course, based on a larger number of cases than those computed in 1908. In both groups the percentage of cures has increased, but the difference remains about the same.

The further investigation of the ultimate results after operation in two stages remains unchanged. In those cases in which the lump was first removed and then, later, the complete operation for cancer was done, there have been no cures. Among the cases in which the breast was first removed and then, later, after microscopic diagnosis, the complete operation for cancer has been performed, there have been no cures. In one case the patient refused further operation. This patient has now remained well seven years, and this represents the only positive cure to-day of an undoubted case of cancer of the breast after an incomplete operation.

Later in this paper I speak of two cures. One of these has since died of cancer.

malignant disease in which a clinical diagnosis cannot be made and in which the diagnosis must be made in some other way. When, however, on account of the difficult diagnosis, the operation is performed in two stages (first, removal of the lesion, and then, after microscopic investigation, after an interval of days or weeks, the radical operation), the probability of a cure is less than in those cases in which the patient has delayed until the diagnosis could be made clinically.

I have investigated this evidence so carefully that it is my belief that I am making no exaggerated statement in regard to the differences in the probability of a cure after operations upon malignant disease, clinically malignant and clinically benign, and the great danger of incomplete operation upon malignant disease when the lesion is clinically benign. I feel that all surgeons and the public should know of these dangers.

At the present time the great majority of surgeons are prepared to treat malignant disease in that late stage when the diagnosis can be made clinically. Their results undoubtedly will differ to a certain extent in proportion to their abilities in the performance of extensive dissections and to their patience in performing these dissections with the greatest amount of painstaking detail. But the actual difference in the percentage of cures will not be very large. Due to the great interest in precancerous lesions, patients all over the country are seeking advice earlier for palpable and visible lesions of the skin and mucous membranes, for lumps in the breast, for pain and swellings about the jaws, for pain and swellings about bones and joints. In many of these cases the disease is in such an early stage that an accurate diagnosis cannot be made from the clinical evidence, and in order to get the best results it must be made at an exploratory incision.

Now, I am quite certain that none will disagree with me in the statement that the majority of surgeons to-day have not prepared themselves to make this diagnosis at the exploratory incision from the gross appearance with or without the aid of a frozen section as accurately as they have diagnosed malignant disease in the late stage without the help of its gross or microscopic pathology. These surgeons have had years of opportunity to examine the gross and microscopic appearance of the various types of malignant disease in the different localizations which they have removed radically, on a diagnosis usually correct, based upon the clinical picture. These opportunities have been lost, and now that the patients are coming earlier with a different clinical appearance, they find themselves unable to employ the older clinical methods and untrained to make the diagnosis from the gross and microscopic pathology at the exploratory incision.

In the Surgical Pathological Laboratory of the Johns Hopkins Hospital, where material is received from many outside sources, our records show that in all groups of cases the number of cases in which tissue is sent to us for diagnosis, tissue removed not radically has increased tremendously. In the past two years we have received more breast tumors than in the previous eighteen, in which only the tumor has been removed and in which our microscopic examination showed cancer. Now, all of these patients had, previous to the incomplete operation, a probability of cure of at least eighty per cent. Now they have ten per cent or less.

Malignant disease in this early stage is not an emergency operation. Surgeons should either prepare themselves to make the diagnosis from the gross or frozen-section appearance at the exploratory incision, or turn this work over to some one who is capable. The responsibility of treatment in the clinically benign stage is far greater than in the clinically malignant stage. Not only is the probability of a cure greater in the early stage, but the danger of any mistake is much greater and the diagnosis is more difficult.

The methods of diagnosis vary with the localization and the character of the lesion. To illustrate the different methods I shall discuss breast tumors, benign and malignant connective-tissue tumors, and some types of epithelial tumors of the skin and mucous membrane.

BREAST TUMORS[1]

The problem of diagnosis here is a very important one, because when a patient seeks advice a few days after a lump in the breast has been observed there are rarely present any clinical signs of cancer. There is no way to make the diagnosis, except by exploring the tumor. It would, theoretically, seem an easy method to excise the palpable mass and subject it to a careful microscopic examination. If this demonstrated the lesion to be benign, no harm would follow. But if it proved to be malignant, my investigation seems to show that the patient's chances of a cure are tremendously reduced by such a procedure.

The percentage of cures among the cases operated upon by Dr. Halsted and his associates in Johns Hopkins Hospital and other hospitals in Baltimore is about forty, after five years. Now, if we consider only those cases which were clinically benign and in which the diagnosis had to be made at the exploratory incision, we find that when the complete operation followed immediately the exploratory incision, the probability of a cure is at least 80 per cent for five years. Among 769 cases of cancer of the breast, in 99 — about 13 per cent — the tumors were clinically benign. In 20 of these cases the tumors only were excised, and later — after some days — the complete operation for cancer was performed. Not one of these cases has been cured. It is only fair to state that this operation was performed by Dr. Halsted or his associates in only two instances. The other eighteen tumors were sent to the surgical pathological laboratory for diagnosis. But I have careful records of the ultimate results. In 15 cases the entire breast was excised; later, after a microscopic examination, in a few the complete operation for cancer was done. So far in this group but two cases were cured — both very early adenocarcinomas. It is possible, therefore, now and then to observe a cure after removal of the breast only for cancer. Here we have 35 cases of cancer of the breast in relatively early stage in which the patients should have had at least eighty chances out of one hundred, in which there have been but two cures — less than six per cent. Contrast with this the 54 cases of cancer of the breast in which the diagnosis was made while the patient was on the table after the exploratory incision and followed immediately by the complete operation for cancer. At least 80 per cent of these patients are remaining well five years and more after operation.

We might deduce from this that it would be the safer procedure to perform the complete operation for cancer in every lump of the breast, but this is contra-indicated by the fact that a large number of relatively young women would be mutilated unnecessarily, and at the same time not completely insured against cancer in the remaining breast.

While we have observed 769 cases of malignant tumors of the breast, we have records of 542 benign lesions. All of the patients suffering with malignant lesions were 25 years of age, or older, at the onset of the disease, while of the 542 patients with benign lesions, about 130 were under 25. Therefore, if a complete operation for cancer had been performed for every lump in a woman over 25, about 50 per cent would have been unnecessarily mutilated.

Therefore, if we are to educate women that a lump in the breast is an acute disease and should be investigated immediately, surgeons must educate themselves to make the diagnosis at the exploratory incision. Although today the number of such cases is relatively small, it is bound to increase if this educational propaganda has the desired effect.

At the present time, when a lump in the breast is explored, it is not difficult to make the diagnosis. We can be quite sure from the gross appearance, with or without a frozen section, that we are dealing either with a benign or with a malignant lesion. In Dr. Halsted's clinic the mistake of diagnosing a cancer as a benign lesion has occurred but twice. This is a fatal mistake. On the other hand, the mistake of treating a benign lesion as malignant, while mutilating, has no element of danger. This has been done much more frequently in this clinic. Among 542

[1] Bloodgood: Senile Parenchymatous Hypertrophy of the Female Breast and Its Relation to Cyst Formation and Carcinoma, Surg., Gynec. and Obst., 1906, December, p. 721; The Clinical and Pathologic Differential Diagnosis of Diseases of the Female Breast, Am. J. M. Sc., 1908, February, p. 157; Cancer Cysts of the Breast and Their Relation to Non-Malignant Cysts, J. Am. M. Ass., October 30, 1909, p. 1475; Kelly and Noble: Inflammations and Tumors of the Female Breast, Gynecologic and Abdominal Surgery, 1908, ii, 180.

benign lesions from all sources 54, or 10 per cent, have been incorrectly treated for cancer. The rule should be that when in doubt, the breast lesion should be treated as malignant. I am confident that when this is done the fatal mistake of an incomplete operation for cancer will rarely, if ever, be made. But the complete operation for a benign lesion will take place in most experienced surgeons' hands in at the most 10 per cent of the benign cases.

It is interesting to note that among these 54 benign lesions which were treated as malignant, in 27 cases the diagnosis of malignancy was based upon the clinical appearance alone. That is, associated with the benign lesion there were some changes in the nipple or skin which as a rule are the signs of cancer. In 24 cases, the diagnosis of cancer was based on the gross appearance at the exploratory incision; in five cases on the frozen section. It would be natural to ask whether, in these twenty-two cases in which the diagnosis of malignancy was made from the gross appearance, a frozen section would not have aided in the diagnosis. I am inclined to think that it would have left the surgeon still in doubt.

From my experience, conversation and correspondence with surgeons and pathologists throughout the country, I get the impression that the majority do not realize the danger of incomplete operations for cancer of the breast, or from two-stage operations, such as removal of the tumor or the breast, and later, after microscopic diagnosis, the complete operation for cancer. Surgeons and pathologists not knowing the fatality of such a mistake are less chagrined than when they make the other mistake of diagnosing and treating a benign lesion as cancer. With this knowledge, all of us should, when in doubt, treat the breast lesion as malignant and expect as the natural consequence to perform now and then the cancer operation for a benign lesion.

The following exact figures of the possible mistakes in the different types of benign lesions are recorded here for the interest of surgeons and pathologists who are called upon to make this diagnosis.

I shall not discuss this problem further, nor give any illustrations, because the entire subject is about to be published in detail as presented in the Muetter Lecture in Philadelphia last December.

*Connective-tissue tumors.* Taking for consideration those tumors which arise in the derma (subepidermal), the subcutaneous tissue, the fascia, the sheaths of tendons and nerves and the intermuscular connective tissue, we have 406 distinctly benign cases and 132 sarcomas. The probability, therefore, of malignant disease is about 25 per cent. Many of the sarcomas developed in pre-existing lesions which may be looked upon as benign. In sarcoma of the skin where, on account of its position, the pre-existing lesion is easily visible and palpable, the number of such cases is larger. For example, in 48 sarcomas of the skin the malignant tumors developed in a nævus 8 times, in a scar 20 times, in a fibroma 9 times. There were, therefore, only 11 cases in which the previous presence of a benign lesion could be excluded. In sarcoma of the subcutaneous tissue it is more difficult to demonstrate a pre-existing benign lesion, but the long duration in many cases of the palpable mass before any local growth suggestive of malignancy would indicate this probability.

If these subepidermal and subcutaneous tumors are attacked surgically very quickly after their first appearance, the problem of differential diagnosis between the benign and malignant, although it may be difficult, is, in the great majority of cases, not at all essential for treatment, because these lesions in their beginning can be radically removed by complete local extirpation without danger or mutilation, and it makes little difference what the microscopic section shows, except as to the prognosis. The locally and completely removed sarcoma, when it is not cured, kills by metastasis through the blood-vessels, and no local operation, no matter how extensive, will influence this result.

In a few instances, on account of the position and extent of the local growth, the differential diagnosis between a benign and malignant lesion may be necessary to save the patient from a more extensive local operation which would be indicated for sarcoma and unnecessary for a benign lesion. In our experience this rarely happens. In 406 dis-

tinctly benign lesions the operation was performed on the diagnosis of sarcoma in 82 cases, but in only 5 cases did this more extensive eradication unnecessarily mutilate. In these five cases an amputation was done. On the other hand, a correct surgical diagnosis from the clinical history and gross appearance saved patients from the mutilation of amputation 8 times. Correct diagnosis, therefore, in 406 cases would have saved mutilation in 13 instances.

The microscopic differentiation between certain types of benign connective-tissue lesions and sarcoma is so difficult, especially in those types of sarcoma in which the probability of a cure after complete local eradication is so large, that in my opinion, based upon this investigation of 538 cases, I should always incline to the diagnosis of malignancy when in doubt. In the vast majority of cases such a more extensive operation will not increase the risk or the mutilation.

On the other hand, it is much simpler, except for the angioma, to completely excise all benign connective-tissue tumors, and in my experience, enucleation should never be done. With few exceptions these benign connective-tissue tumors can be radically excised by cutting through healthy tissue beyond the new growth just as one should do in sarcoma, and thus treat the case as a sarcoma. After such an operation the most expert cellular diagnosis will cause the surgeon no anxiety.

There are, however, a few cases in which a differential diagnosis is essential to save mutilation, but fortunately in these few cases the infiltrating character of the local growth is such that if it is sarcoma little could be expected as to a permanent cure from removal, no matter how complete, while for the benign lesion such a mutilating operation would be unnecessary.

This is true in certain types of intermuscular hæmangioma and in fibrohæmangioma; in myositis where the absence of bone formation makes the identification of the benign lesion more difficult. It is also true in some extensive fibrospindle-cell-tissue formations in scars and in the desmoid tumors of the abdominal wall. In all the cases in which I had an opportunity for investigation the sarcomas, which might simulate these benign lesions were hopeless, while the benign lesions when recognized have been cured by less mutilating operations.

In differentiating this more difficult group surgeons are aided by an accumulated experience of the results of operations for the different lesions in the different localizations.

In tumors of the tendon sheaths, of the abdominal wall, especially of the recti, in scars, and in fibromas, we see cellular pictures resembling very closely periosteal sarcoma of bone. In the former lesions we rarely fail to cure, in the latter the reverse.

I am unable to find in the literature a comprehensive investigation of connective-tissue tumors, benign and malignant.

That I have called these 406 cases benign is, of course, no absolute proof of their benignity, because in the majority of cases the local operation was sufficiently radical to have cured some types of sarcoma. The ultimate results, however, in these 406 cases show no deaths from malignancy, even in a smaller group in which the lesion was not radically, or even completely, removed. There have been recurrences in a few, especially the angiomas and in scar-tissue tumors, but in these cases secondary operations have accomplished cures.

On the other hand, the ultimate results in 132 cases of sarcoma confirm the diagnosis in the majority, but among those cases which have remained well one might question the diagnosis of sarcoma.

In sarcoma of the skin there are 14 cases of round-cell angiosarcoma of the perithelial type and but one cure, while among 20 sarcomas in scar tissue we are certain of 8 cures, and 7 deaths from sarcoma. In how many of the 8 cases was the lesion really a sarcoma? The same question might be asked in 9 cases of sarcoma of the skin which developed in fibromas. We know that six are cured, three were not. Among the two cases of multiple sarcoma of the skin and three of mycosis fungoides there is not a single cure. The cures, therefore, in sarcoma of the skin, with one exception, are in a type of sarcoma most difficult to differentiate from fibroma or keloid. What the results would have been in

Fig. 1. Path. No. 13360. Hæmangioma, skin of finger. Age 15, tumor 3 months. Ulceration following trauma 3 weeks. Excision with Paquelin cautery to base. No recurrence. See Fig. 2 for photomicrograph.

these 48 cases of sarcoma of the skin, had the patients sought advice early, is difficult to state. In only six cases the lesion had been present less than one year. Three of these cases have been cured. The type of the sarcoma in three cases that have not been cured was the most malignant — perithelial angioscarcoma. In the remaining cases the lesion had been present one or more years, and we naturally ask the question, Would not the number of cures have been increased by earlier intervention, especially among the sarcomas in scars, fibromas, and nævi? In all of these cases at the onset radical operations could have been done without mutilation. The

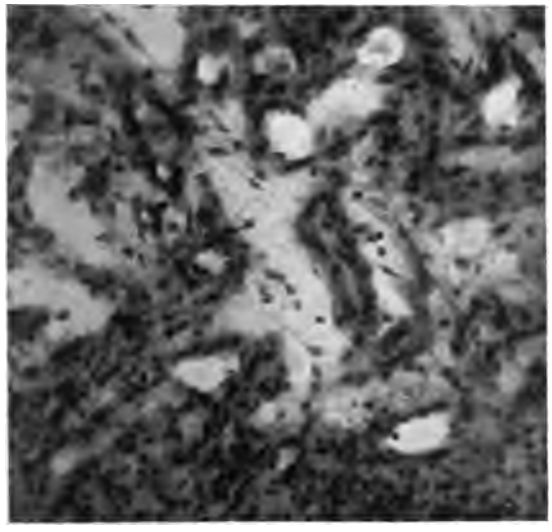


Fig. 2. Path. No. 13360. Photomicrograph of Fig. 1. Ulcerated subepidermal hæmangioma of finger. This section would exclude sarcoma. The patient was sent into the clinic with diagnosis of sarcoma for amputation of the finger.

Fig. 3. Path. No. 12450. Hæmangioma, subepidermal and subcutaneous. White male, aged 24; skin nævi and subcutaneous compressible nodules for years; rapid growth following trauma 3 weeks. Tumor infiltrating. Sent to St. Agnes clinic with diagnosis of sarcoma for amputation. Compressibility and change in size exclude sarcoma. Complete excision. Microscopic section shows hæmangioma and lymphangioma. No recurrence; good function of arm.

hope to cure a sarcoma of the skin of the more malignant type, not developed in pre-existing lesions, must depend upon the education of the public, physician and surgeon to the necessity of immediate local and complete extirpation. For example, in four cases of perithelial angiosarcoma the little lesion was

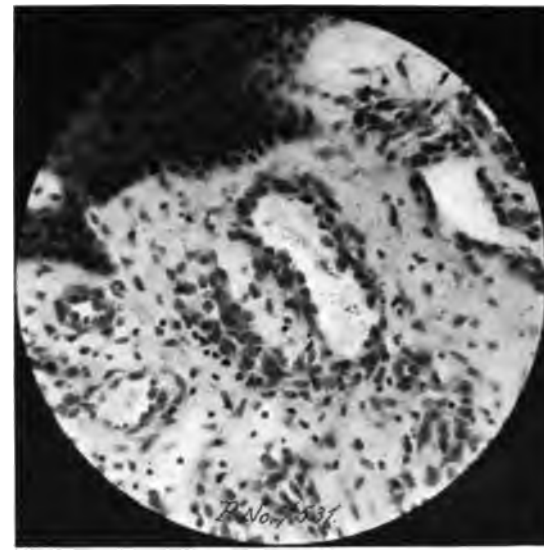


Fig. 4. Path. No. 7531. Hæmangioma, back of hand. Tissue sent from dispensary with diagnosis of sarcoma. The tumor had ulcerated after trauma, similar to Fig. 1. The section shows a hæmangioma; very cellular, due to perithelial and endothelial proliferation. Piece of epidermis shown in section.

Fig. 5. Path. No. 13188. Congenital hæmangioma of face. Male aged 58; at birth tumor size of ten-cent piece below eye; gradual growth; fifteen years ago unsuccessful treatment with Paquelin. Photograph shows condition before treatment at age 58.

present in the scalp and could not be differentiated clinically from an ordinary wen. These tumors were operated on from six weeks to two years after onset. None were cured. Most surgeons look upon the appearance of the scalp tumor, clinically like a wen, as an

Fig. 7. Path. No. 1620. Sketch of the tumor masses exposed at operation by Harvey Cushing. See Fig. 6.

innocent lesion, but our experience shows that there is a possibility of the most malignant type of sarcoma. Therefore all such tumors should be completely excised at once. The most radical extirpation here is not mutilating. The danger of the delay is not in a local recurrence, but in metastasis.

*Hæmangioma.* We have for study 132 cases of benign hæmangiomas, which have been subdivided as follows: Hæmangioma of the skin or subcutaneous tissue, 95 cases; incorrect diagnosis, 9 cases. But in these cases the complete local excision on the diagnosis of sarcoma did no harm. In four cases in which the ulcerating tumor was situated in the neck of young children, the correct diagnosis saved

Fig. 6. Path. No. 1620. Fibrohæmangioma about ankle-joint. Male aged 46, tumor 24 years; first compressible with variation in size, now hard and nodular. Sketch of condition about ankle. See Figs. 7, 8, and 9 for gross and microscopic pictures. Clinical diagnosis sarcoma; partial excision, because amputation refused. Patient well over sixteen years after operation.

Fig. 8. Path. No. 1620. Photograph of alcohol specimen in case illustrated in Fig. 6. Note the white areas and the dark brown spongy areas. From the spongy areas blood could be expressed in the fresh specimen.

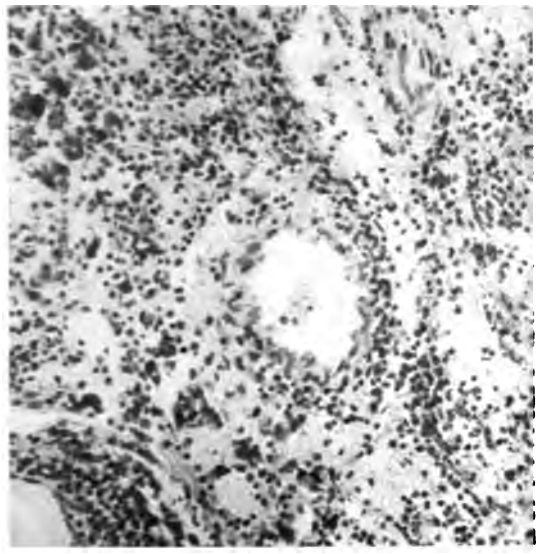


Fig. 9. Path. No. 1620. Photomicrograph of case shown in Fig. 6. Fibrohæmangioma. High power of fibrous area. Note cavity lined by endothelial cells.

Fig. 10. Path. No. 13172. Intermuscular hæmangioma. Photograph to illustrate compressible swelling of leg at X. Male, aged 20; pain in leg eight years; compressible lumps seven years, becoming larger when patient is standing. At operation, masses of varicose veins, subcutaneous and intermuscular, red, spongy vascular tissue. Partial excision, Paquelin. No recurrence one year since operation. Good function.

these patients from more dangerous and mutilating operations.

The hæmangiomas are most frequently congenital tumors. They are usually situated subepidermally. In this situation they can be recognized by their color as well as by their compressibility. In the subcutaneous tumor we have only the compressibility and changes in the size of the tumor to indicate the diagnosis. The ulceration of the congenital or acquired subepidermal hæmangioma is not a sign of malignancy. The epithelial covering of the angiomatous tissue is so thin that it is easily destroyed by a trauma, irritation, or even local growth of the tumor (Figs. 1 and 2). Ulceration of the subcutaneous tumor in my experience has always been a sign of malignancy, unless there has been a severe trauma, or an exploratory operation.

Acquired angioma may be both subepidermal and subcutaneous (Fig. 3). These tumors are often extensive and follow the course of the superficial veins. In the case illustrated in Fig. 3 one could be quite certain that if it were sarcoma the chances of a cure, even by amputation, would be nil. A sarcoma of this size and infiltrating character would have given metastasis. This case was treated on the diagnosis of an angioma, and the ultimate result confirmed the diagnosis.

The microscopic diagnosis of the benign angioma is readily made when we find numer-

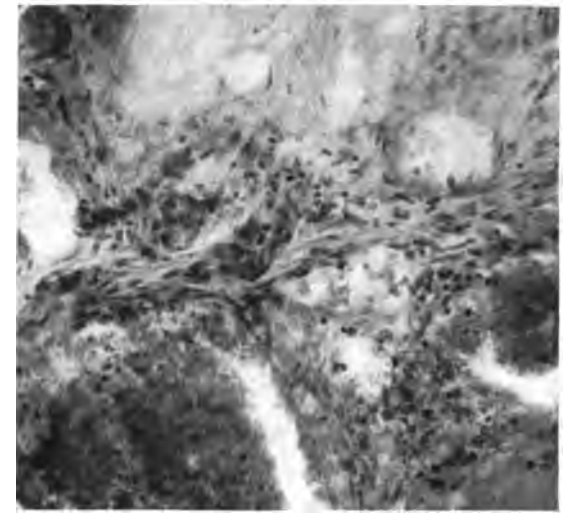


Fig. 11. Path. No. 13172. Photomicrograph of intermuscular hæmangioma in case illustrated in Fig. 10. Note the marked endothelial proliferation in some of the blood spaces.

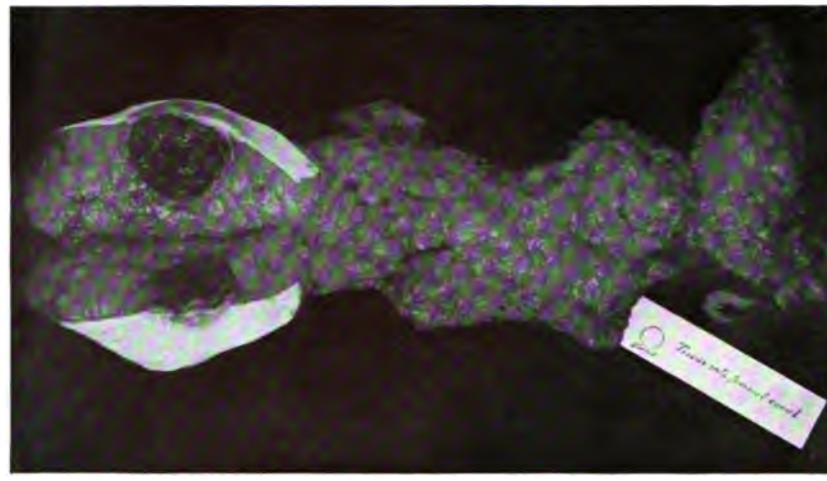


Fig. 12. Path. No. 9063. Sarcoma (?) in congenital nævus. White female, aged 67; small nævus on inner aspect of thigh; growth slow for three years; rapid past six months. Exploratory incision three weeks. The photograph illustrates tumor and subcutaneous tissue removed from thigh and groin. No metastasis to glands. Well five years since operation. See Fig. 13 for microscopic picture.

ous blood spaces lined by endothelial cells (Fig. 4). In sarcoma these blood spaces may be present, but they are very few in numbers. In some hæmangiomas the blood spaces are so small and are so often filled with proliferating endothelium that a diagnosis of a malignant endothelioma might be made. In other cases about the small endothelium-lined blood spaces the stroma of the angioma is filled with round cells and a differential diagnosis from a perithelial angiosarcoma might become difficult. This is especially true when ulceration has taken place. In my own individual experience there has never been any particular difficulty in diagnosis when this differential diagnosis was really necessary, because in all doubtful cases the complete eradication has so far been possible, and in a few, when this would have been dangerous or mutilating, we have been able to make the diagnosis from a combination of the clinical, gross, and microscopic features. In my experience, in benign angiomas there always remains some spongy tissue from which blood can be expressed. I have not seen this in sarcoma. This gross appearance has been more helpful than the microscopic picture.

Fig. 13. Path. No. 9063.] Sarcoma (?) in congenital nævus (see Fig. 12). Low power. Very cellular tumor, but endothelial spaces of capillary angioma preserved.

The danger of a sarcoma developing in a hæmangioma is relatively small, but the possibility must always be considered. We have at least 36 cases of sarcoma in which the type suggests its development from an angioma. In some the angiomatous tissue may have been the result of granulation tissue after trauma, and not developed from a pre-existing angioma. In 12 sarcomas of the skin of the perithelial-angiomatous type there is no doubt that in 6 cases the sarcoma developed in a congenital nævus.

Neglect to immediately remove or eradicate with carbon dioxide snow has another danger besides the possibility of a malignant change,

Fig. 14. Path. No. 13280. Sarcoma (?) of skin in fibroangioma. Photograph of section through recurrent tumor. The dark areas are due to blood pigment. White female, age 79; blood blister on heel three years; tumor two years; removed two years ago; recurrence six months ago; complete excision of tumor and scar. (See Figs. 15 and 16.)

and that is a huge local growth which itself is mutilating, and operation for a cure in this stage difficult, often dangerous, tedious and always mutilating (Fig. 5.)

*Fibroangioma.* Fifteen cases: 5 incorrect diagnoses of sarcoma, which, however, did not lead to mutilating operations, because in two in which amputation would have been indicated on such a diagnosis the patients refused this operation and submitted only to a local extirpation which in both instances was incomplete. Yet both these patients are well seventeen and twelve years after operation.

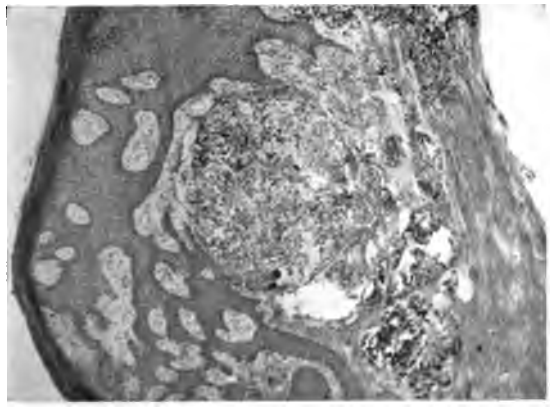


Fig. 15. Path. No. 13280. Photomicrograph, low power, through tumor shown in Fig. 14. Benign hypertrophy of epidermis; pigmented, vascular, cellular growth beneath, with spaces of various sizes lined by proliferating endothelial cells.

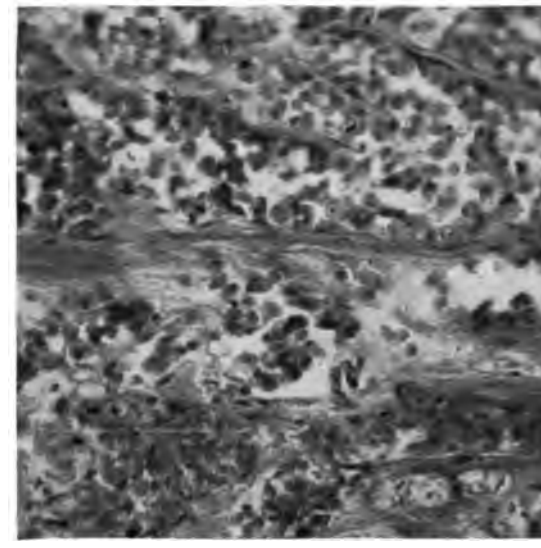


Fig. 16. Path. No. 13280. High-power photomicrograph shown in Fig. 15. Alveoli of endothelial cells with and without pigment in fibrous stroma.

These two cases must prove that the diagnosis of a benign lesion is correct, because gross and microscopic, there is no difference between the tumors completely eradicated in 13 instances, and these two incompletely removed.

Fig. 17. Path. No. 13728. Sarcoma in fibroma, recurrent after enucleation. Photograph of specimen removed. The specimen has been cut and shows skin, tumor, and underlying muscle.

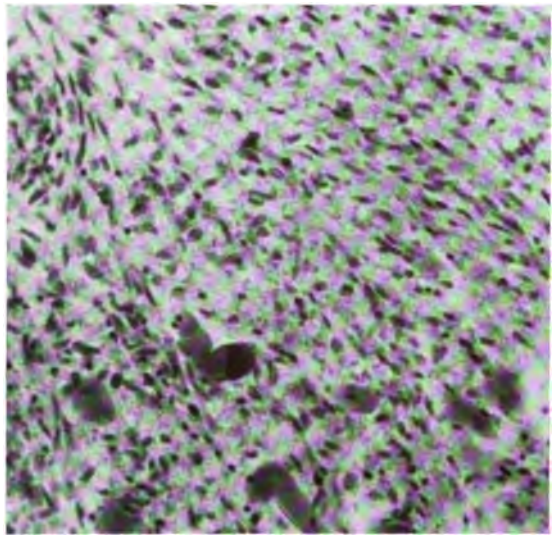


Fig. 18. Path. No. 13728. Fibro-spindle-cell sarcoma in fibroma. See Fig. 17 for gross appearance. This represents a very cellular area infiltrating muscle.

Fibroangioma is apparently the result of an inflammatory reaction in a hæmangioma. This reaction is either due to trauma or interference with the circulation. The increasing tumor, originally compressible and showing changes in size, becomes harder, the compressibility disappears, the change in size is not observed. If it is situated near the skin the thin epidermis may ulcerate. In gross appearance we see two distinct types of tissue: red, spongy, vascular areas resembling capillary angioma, and firm, white areas more like fibrospindle-cell sarcoma than fibroma. Even in the gross, pigmented areas may be seen. Under the microscope in the vascular, red areas, we see the picture of angioma. Frequently the blood spaces are plugged with endothelial cells giving the picture of an endothelioma. The white areas are cellular with varying amounts of eosin-staining fibrous tissue, and we see numerous areas of endothelial cells in nests in this cellular connective tissue. Blood pigment from old hæmorrhage is observed in the cells of different types and in the stroma. From a histological study these tumors are difficult to differentiate from sarcoma. The importance of the differential diagnosis is present only when complete eradication would be mutilating. In 13 of the 15 cases, complete excision was possible without danger or mutilation. In three of these cases the operative diagnosis was sarcoma. All of these patients have remained well since operation. In one case (Fig. 6) the tumor was present about the ankle-joint, but the patient refused amputation. Tumor tissue was left attached to the tendon sheath. This patient is well (June, 1913), sixteen and one-half years since operation. Fig. 6 is a sketch of the clinical appearance, Fig. 7 a sketch of the operative findings, Fig. 8 a photograph of the gross specimen, and Fig. 9 shows the microscopic appearance. In the second case the tumor was situated in the muscle of the thenar eminence of the right thumb. The partially removed tissue was sent to the laboratory with the diagnosis: sarcoma, tumor incompletely removed, patient refused amputation. This patient is well (June, 1913), almost twelve years since operation.

*Intermuscular angioma.* Nine cases: 4 incorrectly diagnosed and one of these subjected to an unnecessary amputation of the thigh.

*Intermuscular hæmangiomas* should not be difficult to recognize. They appear as diffuse

Fig. 19. Path. No. 7432. Sarcoma (?) in skin scar. Photograph of patient. White female, aged 36; chronic acne and blackheads many years; induration eighteen months; tumor nine months. Incomplete excision. No recurrence six and one-half years.

compressible swellings, often visible externally (Fig. 10). The swelling shows variation in size when the limb is lowered or raised, or when constrictions are made on the veins above. Often the superficial veins are dilated. In some instances diffuse lipoma and multiple tuberculosis of the tendon sheaths may give a somewhat similar clinical picture. At the exploratory incision numerous dilated veins are encountered, and in and between the muscles one sees red, spongy, angiomatous tissue.

Microscopically (Fig. 11), we may find every type of an angioma from a capillary to cavernous. The amount of stroma varies; endothelial proliferation in the blood spaces is very common. This tumor may be situated anywhere. We have observed it three times near the masseter of the cheek, twice on the forearm, twice in the muscles of the calf of the leg, and twice in the thigh. With this experience one might feel quite certain that the differential diagnosis from an intermuscular sarcoma is not difficult. Complete removal for the intermuscular hæmangioma is not necessary and need never be performed if such a procedure would be mutilating. The scar tissue of the partial excision and in some cases the employment of the cautery will destroy the vascular tissue with little or no injury to muscle function.

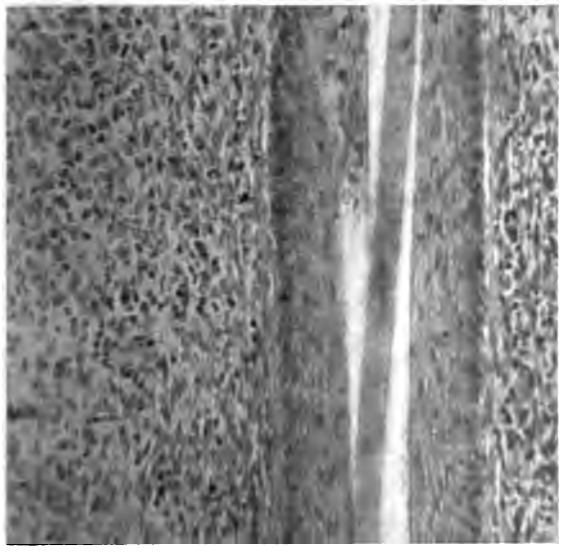


Fig. 20. Path. No. 7432. High-power photomicrograph from case illustrated in Fig. 19. Although this cellular tissue looks like sarcoma, the hair follicle is uninjured. I have never observed this in sarcoma.

Fig. 21. Path. No. 14056. Pigmented fibroma of the skin after injury with piece of coal. Complete local excision. This area was similar to the one in which the sarcoma illustrated in Fig. 22 developed.

*Granulation-tissue tumors.* Thirteen cases. Pieces of six of these tumors were sent to the laboratory diagnosed sarcomas, and these patients were saved unnecessary and mutilating operations. These granulation-tissue tumors occur on the skin, and are either due to the ulceration of a pre-existing hæmangioma, or to exuberant granulation tissue in a superficial wound. A tumor of this kind presents a small fungus covered with granulation tissue, not unlike an ulcerating sarcoma (Figs. 1 and 2). In my experience the local growth is never as great as in the sarcoma. Microscopically, this tumor is very

Fig. 22. Path. No. 2886. Round-cell sarcoma, in skin scar. Male, aged 34; pigmented scar four years after trauma from lump of coal; two years later growth in scar; six months ago incomplete excision; immediate recurrence. The photograph shows the recurrent growth on forehead. This patient died in one year of internal metastases; no local recurrence. See Figs. 23 and 24 for gross appearance of the recurrent tumor excised.

cellular, but the endothelium-lined blood spaces (Fig. 4) are always more numerous than in sarcoma, and the stroma is of the type of granulation tissue.

*Angiosarcoma.* In six cases of sarcoma of the skin arising in congenital nævi there has been one cure. In five instances the tumor, when it came under observation, was a fungus and inoperable from local growth or metastasis. In the history of all of these cases there had first been a local growth in a nævus quiescent for many years, from four to seventy-four years. The character of this local growth was sufficient to indicate immediate radical excision. The ulceration took

Fig. 23. Path. No. 2886. Surface of recurrent tumor excised from patient shown in Fig. 22. Note peculiar ulceration.

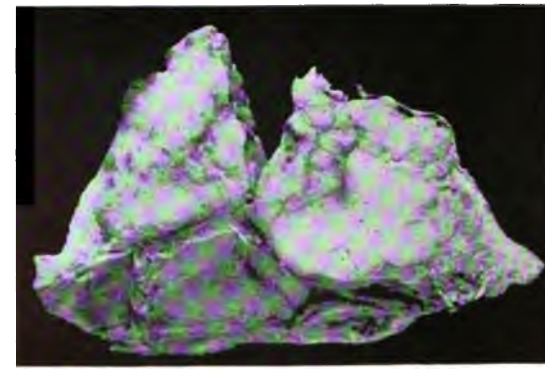


Fig. 24. Path. No. 2886. Cross section through tumor shown in Fig. 23.

place at varying periods after the onset of growth, from a few months to three years. It is impossible to say, of course, what these tumors looked like in the onset. When they came under observation they were very cellular, friable, vascular neoplasms resembling hæmorrhagic brain tissue, microscopically, round-cell sarcoma of the perithelial type. In the one case cured by radical excision the tumor situated in the skin of the thigh was the smallest observed. The local growth had been present about six months (Fig. 12). Histologically, this tumor suggests that it might still be an angioma, and not an angiosarcoma (Fig. 13). Endothelial blood spaces are still preserved, but the tissue between them is very cellular and resembles sarcoma more than granulation tissue. This patient has remained well five years since operation.

It is my opinion that we should be able to recognize the development of a sarcoma in a congenital nævus and cure the majority of cases by immediate radical excision.

In nine cases of sarcoma of the skin resembling the previous cases clinically and pathologically there has been one cure. The duration of the nodule has varied from six weeks to seven years in patients whose ages varied from four years to seventy. Three had been present on the scalp and were clinically like an ordinary wen, one as a blood cyst of the cheek, one in the neck, two on the eyelid, one in the skin above the pubes, one near the ankle. In all of these cases there had been a definite trauma, and in some, recurrent irritation.

The cured case began in a varicose vein near the external malleolus; it recurred after the first excision, and has now remained well two years after the removal of the recurrent nodule. Fig. 14 illustrates a section through the small recurrent tumor. It resembles somewhat the fibroangioma. Figs. 15 and 16 are from a section of the recurrent tumor. Histologically, it suggests an endothelioma; the pigment is due to hæmorrhage. It is quite natural to ask, Is this an angiosarcoma or a fibroangioma?[1]

Among the 22 cases of angiosarcoma there is not a single cure. In 11 cases the lesion had been present years or longer, in 11 cases months. Trauma is the most common etiological factor, suggesting the possibility of the development of a sarcoma in the granulation tissue secondary to trauma, or the effect of injury on a pre-existing angioma.

In none of these tumors was there any difficulty in making a diagnosis from the clinical appearance or the gross and microscopic pathology when they first came under our observation.

The differential diagnosis in this group, if seen or explored early, would have to consider and exclude tubercular myositis, syphilitic gumma, non-ossifying myositis, intermuscular angioma and fibromyxoma of nerve sheaths. I am unable to present exact methods based upon experience, because none of these lesions have presented themselves clinically in the early stage. The Wassermann reaction and therapeutic effect of salvarsan have so far in my experience allowed us to make the correct diagnosis in gumma. Tubercular myositis has always come under observation in the abscess stage. After a contusion to the soft parts, if the resultant swelling does not disappear rapidly and the X-ray shows no ossifying myositis, the lesion should always be explored. Only in this way will we get in the early and possible curable stage sarcoma secondary to trauma. The first appearance of a subcutaneous mass, whether it be circumscribed or diffuse, should demand immediate investigation. In the absence of a positive Wassermann it should be explored. Only in this way will we be able to treat sarcoma in the earlier stage. It must be remembered, however, there may be great danger in these early explorations, if the surgeon is not qualified to make the differential diagnosis. The larger number of cases are benign. Especially is this true of traumatic myositis and organizing hæmatoma. Here operations on the diagnosis of sarcoma would be mutilating and unnecessary.

*Fibroma.* I have records of 34 cases of fibroma of the skin and subcutaneous tissue, 13 desmoids or fibromas of the abdominal wall, 20 tendon-sheath tumors, and 49 scar-tissue tumors, or keloids — 116 tumors, therefore, of the benign type. During the same time we have observed the following cases diagnosed sarcoma: 20 cases in scars, 9 in fibroma, and 8 fibrospindle-cell tumors situated subcutaneously — in all, therefore, 37 sarcomas. The more I study the cellular pathology of fibroma and fibrosarcoma, the less do I feel able to recognize the border-line lesion. Fortunately, it makes little difference, except in a few cases. These tumors, as a rule, are circumscribed and can be completely and radically removed. If this is done, the majority are cured.

These tumors should never be removed by enucleation. Fig. 17 illustrates a recurrent sarcoma situated in the skin over the shoulder blade. When it first appeared it was the size of a pea. After it had been present some months and had reached the size of an egg it was enucleated under cocaine. The tumor promptly recurred. Four months later when I saw the patient, the recurrent tumor was the size of two fists (Fig. 25). It was now removed with a wide zone of skin, fascia and muscle, and the area skin-grafted. The microscopic appearance of the tumor (Fig. 18) is so cellular that I think we are perhaps justified in calling it a fibrospindle-cell sarcoma.

*Keloids.* The ordinary benign keloid should not be difficult to recognize. These tumors often recur after complete excision. Yet I have never observed a sarcoma to develop in a true keloid. If the keloid is subject to trauma it may ulcerate.

In other cases the tumor developing in scar

[1]December, 1913. There is now a local recurrence in the scar, but no signs of metastasis. Duration of disease now four and one-half years, rather long for sarcoma.

tissue may be very difficult to distinguish from sarcoma. Fig. 19 represents a tumor of the back developing after a long history of acne and blackhead formations. The area was excised eight years ago. The microscopic pathology (Fig. 20) demonstrates that the neoplasm is composed of a cellular tissue about hair follicles. This microscopic change was present up to the border of the tissue excised. Nevertheless, there has been no recurrence. Many pathologists who have examined this section for me are of the opinion that it is a sarcoma. If it is, it is one that may be cured by incomplete removal.

Clinically, I was of the opinion that this case was a carcinoma developing in hair follicles or glands of the skin, secondary to chronic irritation of the acne. I removed the zone shown with a wide margin, but when I studied the edges and found the cellular tissue present beneath the epidermis, I felt that it was sarcoma. Metastasis must have taken place, and there was no indication to remove more than one-fourth of the skin of the back. After careful investigation I concluded that it must be an inflammatory tumor. The result has confirmed this.

There is no doubt that the most malignant sarcoma may develop in scars of different types. Fortunately I have observed examples of the beginning and the end of such lesions. Fig. 21 illustrates an area on the face secondary to an injury with a piece of coal. It was pigmented, raised. Microscopically, it shows cellular granulation tissue and coal pigment. It was removed a few months after the injury, and there has been no recurrence.

Fig. 22 pictures a man who had a similar area after an injury with a piece of coal on the forehead. Some years later when it increased in size, it was incompletely removed on the diagnosis of keloid. The picture illustrates the recurrent tumor, which was radically removed (Figs. 23 and 24). It proved to be a round-cell sarcoma. The coal pigment was still present. The patient died of internal metastasis.

# THE POST-OPERATIVE RESULTS OF TRACHELORRHAPHY IN COMPARISON WITH THOSE OF AMPUTATION OF THE CERVIX [1]

By V. N. LEONARD, M. D., Baltimore
Assistant Resident Gynecologist, Johns Hopkins Hospital

IN the year 1862, it happened that Sims, on leaving the country for a visit to certain European clinics, referred to his associate, T. A. Emmet, a patient who had suffered for years with an "ulcerated cervix" and had become a confirmed invalid. After treating the case for some time by the usual methods and with the usual disappointing results, Emmet (1), one day while examining her, more or less by accident discovered her real condition to be a bilateral laceration of the cervix, and immediately devised an operation to restore the cervix to its normal outline. Speaking of this discovery, some twenty years later, Wells (2) says: "Though for more than two centuries the thinking minds in the profession had recognized, more or less clearly, the dependence of the then called 'ulcerations' upon previous laceration of the cervix, no one seems to have realized fully the feasibility of curing the lesion by closing the laceration, and the honor of inaugurating a new era in the treatment of these fissures was reserved for the clear seeing genius of Emmet, who recognized and showed, as had no one before, the real nature and importance of this frequent 'ulceration' of the parous cervix."

On November 27, 1862, Emmet first performed the operation of trachelorrhaphy on Sims' patient, with what proved to be brilliant results. It was not, however, until eight years later, when he had repeated the operation some two hundred times, that Emmet reported the technique of his procedure and the gratifying results obtained. In a paper read before the Medical Society of the County of New York on September 28, 1874, Emmet describes his first case in these words: "While making a digital examination one day, I was puzzled to account for the greater width of the cervix in comparison to that of the body beyond, a condition I had for the first time appreciated. I placed her on the left side, and with a Sims speculum brought the cervix in view. I drew the posterior lip forward towards me, with no special purpose, when I was surprised to observe that it had decreased to nearly half its previous size. On lifting up the anterior lip with a tenaculum in the other hand, so as to bring the two portions in approximation, the outline of a cervix presented of nearly a normal size. The difficulty was at once apparent, for the parts had rolled back within the uterine canal, and a deep lateral fissure became evident, which extended on each side entirely through the cervix and beyond the vaginal junction. On separating the flaps and forcing them back to their former position, I saw the tissues gradually roll out, and the cervix again present its previous appearance. The remedy at once suggested itself." In discussing Emmet's paper at this meeting, Sims (3) paid high tribute to his work with the statement: "We can't modify the operation. We can't change it, for it is perfect—perfect in its method, and perfect in its results." As much due to the support of such men as Sims, Thomas, Fordyce Barker and Goodell as to the really great importance of Emmet's discovery, the operation almost immediately gained widespread use throughout America and England and before many years was practiced to some extent in Germany and France. In the latter countries, however, it has never won the recognition and use it has so well merited.

In the April (1913) issue of this journal, the writer reported an analysis of the post-operative results of the cases of amputation of the cervix performed in the Gynecological Clinic of the Johns Hopkins Hospital during the past twenty years, a complete post-operative history having been obtained in 128 of the 400 cases recorded in the protocols of the department. The conclusions reached by an analysis of these cases were quite unexpected, and, in many ways, disappointing.

[1] From the Gynecological Clinic of the Johns Hopkins Hospital.

Although the results obtained regarding the improvement in the general health and the cure or amelioration of leucorrhœa showed the operation to be highly efficient in these respects, the more important facts brought out by the analysis were in connection with the marital histories of these cases, following operation. Of those women, in whom the occurrence of a pregnancy might naturally have been expected, four-fifths remained sterile. On the other hand, over 50 per cent of the pregnancies occurring after operation ended by miscarriage or premature delivery, while of the few remaining which progressed to full term, even a larger percentage experienced prolonged and difficult labors. The cases reported had all had a circular amputation of the cervix, on an average of about three centimeters of the cervix above the external os being removed, and on learning of the results obtained, Dr. W. W. Russell at once suggested that the cases in which the cervix had been repaired by Emmet's method be followed up in order to afford a suitable basis upon which the two operations might be compared as to their therapeutic efficiency and their effects upon the subsequent marital history. Accordingly, a circular letter was sent to all the cases of trachelorrhaphy performed in this clinic during the past ten years. The number of complete reports received, although disappointingly small, is large enough to furnish a fair comparison of the remote results of the two procedures.

### POST-OPERATIVE HÆMORRHAGE

The danger of serious hæmorrhage after amputation of the cervix has been shown to be very real. The occurrence of a discomforting "ooze" after this operation, requiring the use of tight vaginal packs, is only too familiar. On the other hand, alarming hæmorrhage is by no means uncommon. Of 128 cases in this clinic, 6, or nearly 5 per cent, bled so profusely at some time during the convalescence as to necessitate their removal to the operating room for resuture of the cervix. In each of these cases tight vaginal packs had failed to control the hæmorrhage.

Similar experiences were not unknown to the earlier operators after the performance of trachelorrhaphy, although such cases were very infrequent. Thus, Goodell (4) reports but three instances of post-operative hæmorrhage in over 200 cases of trachelorrhaphy, in which it became necessary to resuture the cervix on this account, while Emmet reports the same number as occurring among some 600 cases. Severe post-operative hæmorrhage in cases of trachelorrhaphy has been very unusual in this clinic and resuture of the cervix on this account has never been found necessary, although in two of the cases reported herewith slight hæmorrhage occurred, necessitating the use of vaginal packs.

In reporting the 6 cases from this clinic in which hæmorrhage occurred after amputation of the cervix, it was pointed out that an added danger from this complication was that it might arise at any time during the convalescence, and even weeks after operation, when the patient had passed from the surgeon's observation. Similar cases of late post-operative hæmorrhage have been reported as following trachelorrhaphy, Wells (2), particularly, having given warning of this danger in reporting several cases in which the hæmorrhage occurred many days after operation.

In 2 cases of the series reported, hæmorrhage occurred of sufficient moment to require packing the vagina. In one case, the bleeding began on the sixth day, and in the other on the seventh. The hæmorrhage was easily controlled in both cases. When we consider that after amputation of the cervix, serious post-operative hæmorrhage occurred in nearly 5 per cent of the cases, it would seem that the comparative freedom from this danger after trachelorrhaphy justifies, in itself, the choice of the latter operation whenever indicated.

### INFLUENCE OF AMPUTATION AND REPAIR OF THE CERVIX ON THE GENERAL HEALTH

A lacerated cervix is more often than not the seat of a chronic infection. That the removal of such a focus of chronic infection should be followed, in a large percentage of cases, by a marked improvement in the patient's general condition is, therefore, not surprising. After amputation of the cervix 91 per cent of 128 cases noticed such improvement. In 13 of these cases, amputation of

the cervix was the only operation performed, yet 12 of these, or 92 per cent, reported improvement in the general condition. After trachelorrhaphy, 34 out of 39 cases, or slightly over 87 per cent, reported noticeable improvement in the general health, a result which compares very favorably with the amputation cases. It should be noted, however, that in this clinic trachelorrhaphy has only been chosen as the method of procedure in those cases presenting one or two more or less discrete lacerations and without a marked endocervicitis. A cervix badly infected or one showing multiple lacerations has almost invariably been amputated. For this reason the results of the two operations can not be quite fairly contrasted in their effects upon the general health. The fact remains, however, that after each operation about 90 per cent of the patients are improved in general condition. The effect of other operations, simultaneously performed, must of course be taken into consideration in determining to what extent this improvement is due to the plastic operation on the cervix.

INFLUENCE OF AMPUTATION OF THE CERVIX AND TRACHELORRHAPHY ON THE GENERAL HEALTH

| | No. Cases | No. Cases Improved | No. Cases Same | No. Cases Worse |
|---|---|---|---|---|
| Amputation of cervix alone or with perineorrhaphy | 80 | 72 (91 %) | 6 | 2 |
| Trachelorrhaphy alone or with perineorrhaphy | 25 | 22 (88%) | 3 | 0 |
| Amputation of cervix followed by abdominal section | 48 | 43 (90%) | 2 | 3 |
| Trachelorrhaphy followed by abdominal section | 14 | 12 (86%) | 2 | 0 |

The table brings out one fact very clearly: the improvement in the general condition following either operation is not entirely dependent upon the abdominal operation performed (in most cases a suspension of the uterus and appendectomy). In each group it will be noted that the percentage of cases reporting improvement is about the same. Inasmuch as the plastic operation on the cervix was the only one common to all these cases, the indication is that its share in producing these results must be, at least, a very important one. In 3 cases, trachelorrhaphy was the only operation performed and each of these report decided improvement in the general condition. In 12 out of 13 cases in which amputation of the cervix was the only operation performed, the same result was obtained. Of the 39 cases of trachelorrhaphy, 5 reported no improvement in the general health. Two of these cases were operated upon recently while in 2 of the 3 remaining cases a very small laceration was resected, the operation being quite atypical. A consideration of the foregoing seems to justify the assertion that in properly selected cases trachelorrhaphy improves the general condition of the patient quite as markedly as amputation of the cervix.

LEUCORRHŒA

Leucorrhœa is the most common and frequently the most distressing symptom of cervical disease. Of the 167 patients requiring either amputation or repair of an infected or lacerated cervix, 85 per cent complained of a vaginal discharge varying in severity from the slight but constant non-irritant leucorrhœa to the profuse, foul, irritating discharge so often the result of a badly infected cervix, and in some instances sufficiently severe as to render the patient practically incapacitated. In this latter group, as has been indicated above, the cervix presenting a marked grade of endocervicitis has almost invariably been amputated, the simpler operation of trachelorrhaphy being reserved for cases showing one or two discrete lacerations, with only a low grade endocervicitis. The results obtained in this group of 142 cases, contrasting the efficiency of amputation of the cervix and trachelorrhaphy in combating leucorrhœa of cervical origin, demonstrates the necessity for a thorough consideration of these indications before proceeding with either operation.

INFLUENCE OF AMPUTATION OF CERVIX AND TRACHELORRHAPHY ON LEUCORRHŒA

| Leucorrhœa before operation | Amputation Cervix | Trachelorrhaphy |
|---|---|---|
| | 109 cases | 33 cases |
| Cured | 68 cases = 62.5% | 14 cases = 42.3% |
| Improved | 33 cases = 30 % | 14 cases = 42.3% |
| No change | 8 cases = 7.3% | 5 cases = 15.5% |
| Worse | 1 case | 0 |

It will be seen that in over 92 per cent of the cases, the discharge either disappeared entirely (62.5 per cent) or was noticeably diminished in amount (30 per cent) after amputation of the cervix. In these cases the cervix was usually the seat of a chronic endocervicitis of relatively high grade and the leucorrhœa proportionately profuse. Contrast now the results obtained in this respect by trachelorrhaphy, remembering that in this group the endocervicitis present was usually but slight and the leucorrhœa a relatively unimportant symptom. It will be noticed that the percentage of cases cured is much lower (42 per cent as compared with 62 per cent) and that the percentage of cases in which the operation had no effect whatever on the leucorrhœa is more than twice as high. In 5 cases after trachelorrhaphy, the discharge present before operation remained unchanged afterward. In 2 of these cases a very small laceration was resected by an atypical procedure, these 2 cases being among the five who also reported no improvement in the general condition after operation, a rather significant coincidence. In one other case the abdomen was first opened and the left tube and ovary removed for a chronic inflammatory condition probably of gonorrhœal origin. It being found unnecessary to drain, the cervix was then repaired and the perineum restored. Inasmuch as this patient had had an infection severe enough to require a laparotomy, it is probable that a marked endocervicitis also existed at the time of operation, and the cervix should probably have been amputated.

Any operative procedure on the cervix, in the presence of a chronic endocervicitis, tends to enliven such an infection temporarily. The earlier operators and especially Emmet (1), recognizing this fact, laid great stress upon the importance of preliminary treatment calculated to reduce the endocervicitis present, before operating for the laceration. The patients were often subjected to months of douching and local treatment before an operation for the closure of the laceration would be attempted. Van de Warker (5) was the first to dispense with all this troublesome preliminary treatment, believing that the closure of the laceration rendered the infection present more amenable to treatment. That even a latent endocervicitis is made temporarily active by either amputation of the cervix or trachelorrhaphy is well evidenced by the fact that almost without exception the 167 cases reported here left the hospital with a more or less profuse vaginal discharge, which continued for an average of about two months. For this reason it has been customary in this clinic to start warm vaginal douches about the ninth or tenth day after either operation, and on leaving the hospital to advise their daily use as long as the discharge continues. Occasionally this post-operative leucorrhœa will endure for a long time. In 3 cases, after amputation of the cervix the discharge continued for more than two years and then ceased entirely in 2 cases, and underwent marked improvement in the other. Amputation of the cervix is then an excellent means of treating intractible cases of endocervicitis, the results of this procedure as regards this particular consideration being excellent in over 90 per cent of the cases. On the other hand it is difficult to imagine how trachelorrhaphy could have any effect on a chronic endocervicitis other than to render it more amenable to treatment, as indicated by Van de Warker. When we contrast the effect of amputation of the cervix and trachelorrhaphy as to their efficiency regarding the cure of leucorrhœa of cervical origin, at least one important fact is made clear: Although the repair of a lacerated cervix may render a mild grade of endocervicitis more amenable to treatment, trachelorrhaphy can not be considered as having any direct effect upon the infection present, other than to enliven it, and that the presence of a marked endocervicitis should therefore be considered as a contraindication to its employment.

### THE EFFECT OF AMPUTATION OF THE CERVIX AND TRACHELORRHAPHY ON DYSMENORRHŒA

It is generally recognized that the occurrence of dysmenorrhœa in multiparæ is rather unusual, yet of 148 cases of laceration of the cervix treated by amputation or trachelorrhaphy in this clinic, only 30 cases, or about 20 per cent, were entirely free from menstrual pain before operation. Many comments as

to the rôle of cervical laceration in the etiology of dysmenorrhœa, "pelvic neuralgia," etc., can be found in the earlier literature, following Emmet's announcement of the importance of this lesion, but no attempt to explain the mechanism of this relationship is made. That some relationship actually exists, however, seems very probable from a consideration of the results obtained in these cases. As when considering the effect of the operation as regards the general condition of the patient, it is necessary, again, to note the influence of any other operation simultaneously performed, in producing a reduction in menstrual pain following operation. Accordingly, the cases have been divided into two groups, the first comprising those cases in which the plastic operation on the cervix was done alone, or in combination with the restoration of a relaxed vaginal outlet, and the second including those cases in which the abdomen was opened. The results are summarized in the following table:

INFLUENCE OF PLASTIC OPERATIONS ON THE LACERATED CERVIX IN THE REDUCTION OF MENSTRUAL PAIN

GROUP I.

A. *Amputation of Cervix Alone, or with Perineorrhaphy*
Dysmenorrhœa before operation.....55 cases
After operation —
Less pain..... 29 cases, or 53%
More pain..... 5 cases, or 9%
No change..... 21 cases, or 38%

B. *Trachelorrhaphy Alone, or with Perineorrhaphy*
Dysmenorrhœa before operation.....15 cases
After operation —
Less pain..... 12 cases, or 80%
More pain..... 1 case, or 7%
No change..... 2 cases, or 13%

GROUP II.

A. *Amputation of Cervix with Laparotomy*
Dysmenorrhœa before operation.....37 cases
After operation —
Less pain..... 25 cases, or 68%
More pain..... 6 cases, or 16%
No change..... 6 cases, or 16%

B. *Trachelorrhaphy with Laparotomy.*
Dysmenorrhœa before operation.....11 cases
After operation —
Less pain..... 7 cases, or 64%
More pain..... 2 cases, or 18%
No change..... 2 cases, or 18%

The following facts are brought out by the above table:

1. Of 148 cases of lacerated cervix, 118, or 80 per cent, had dysmenorrhœa before operation.

2. In 62 per cent of these cases there was noticeable reduction in menstrual pain following operation.

3. Of 70 cases in Group I, 41 cases, or 59 per cent, had less menstrual pain following operation.

4. Of 48 cases in Group II, 32 cases, or 67 per cent had less menstrual pain following operation.

5. Following amputation of the cervix, in 59 per cent of the 92 cases having menstrual pain before operation, the dysmenorrhœa was cured or improved.

6. Following trachelorrhaphy, in 70 per cent of the 19 cases having menstrual pain before operation, the dysmenorrhœa was cured or improved.

In 48 of these cases (Group II) the abdomen was opened. To what extent, then, must this reduction in menstrual pain be ascribed to the abdominal operation, simultaneously performed? The question is answered in part by the table above, and quite fully in combination with the table to follow.

ABDOMINAL OPERATIONS IN GROUP II

| | A. Amputation Cervix | B. Trachelorrhaphy |
|---|---|---|
| Suspension of uterus and appendectomy | 29 cases | 8 cases |
| Removal of one tube and ovary | 2 cases | 1 case |
| Ligation of tubes | 2 cases | 1 case |
| Herniotomy | ..... | 1 case |
| Cholecystostomy | 1 case | |
| Myomectomy | 3 cases | |

It will be seen that in 37 of the 48 cases a suspension of the uterus and appendectomy were done, which might easily account for the reduction of menstrual pain in these cases. The same may be said of the three instances in which the adenexa on one side were removed for chronic inflammatory disease, and likewise might possibly also apply to the three cases in which a myomectomy was performed. In 43 of the 48 cases in Group II, then, any reduction in menstrual pain following operation could not be justly ascribed to the operation on the cervix. Not so, however, with Group I. Here 59 per cent of the 70

cases noted a reduction in menstrual pain — a result which could only be due to the plastic operation on the cervix. In 8 cases, amputation of the cervix was the only operation performed. Four of these cases noticed marked reduction in menstrual pain after operation while the other four noticed no change. In 3 cases, trachelorrhaphy was the only operation performed. Each of these cases noticed a decided decrease in menstrual pain.

The conclusion seems inevitable, that laceration of the cervix bears some definite relationship to dysmenorrhœa in multiparæ, when we consider that 62 per cent of 118 cases of lacerated cervix, suffering with varying degrees of menstrual pain before operation, were entirely relieved or improved by amputation of the cervix or trachelorrhaphy. The results of one operation are about as good as the other in this respect.

### INFLUENCE OF AMPUTATION OF THE CERVIX AND TRACHELORRHAPHY REGARDING THE SUBSEQUENT FERTILITY OF THE PATIENT

The question of the influence of plastic operations upon the uterine cervix as regards the fertility of the patient has naturally been considered under two distinct heads: First, that group of cases in which the operation is undertaken primarily with the idea of relieving a condition of sterility; and, secondly, those cases demanding surgical interference for disease of the cervix, most of these women being multiparæ and the question of post-operative fertility being of secondary rather than of primary importance. The first group has received much attention in the literature, notably through the work of Sims (3), Champetier de Ribes, Simpson, Scanzoni, Pozzi (6), Guibout (7), La Torre (8), Morisani (9), Mangin (10), Duponnois (11), Pescher (12), Doléris (13), etc., — and all seem agreed that amputation of the cervix in cases of sterility due to such mechanical causes as hypertrophic elongation, bring very fair results. The question of the subsequent fertility of those patients coming to operation primarily for disease of the cervix has been practically neglected, however, most of the scant literature that has appeared being very unreliable on account of the faulty, or entire lack of, classification of the cases presented. In the following report, 167 cases are considered in which the full marital history following operation was obtained. The cases are divided into two classes on the following basis:

CLASS A. Married women under 40 years of age at the time of operation who are menstruating regularly now.

CLASS B. (1) Women over 40 years of age at the time of operation. (2) Cases who have passed or are at present in the climacteric. (3) Cases of double salpingectomy or other operation making subsequent pregnancy impossible or very unlikely. The cases of amputation of the cervix, 128 in number, have been previously reported on a basis of this classification. It was found that of the 72 cases in Class A, women in whom the occurrence of pregnancy would naturally be expected, but 14 cases, or 19.4 per cent, reported fertility following amputation of the cervix. In other words, although every one of these 72 women had borne one or more children before operation, over four-fifths of them have remained sterile since. Of the 39 cases in which the cervix was repaired by Emmet's method, 29 fall into Class A of this classification. Of this number, 11 cases or 38 per cent have become pregnant since operation. According to these results, fertility after trachelorrhaphy is just twice as frequent as after amputation of the cervix. The following tabulation is interesting in this respect.

FERTILITY AFTER AMPUTATION OF CERVIX

| | No. Cases Class A | Av. Age at Time of Op. |
|---|---|---|
| | 72 cases | 30 yrs. 5 mos. |
| Fertility reported | 14 cases = 19.4% | 28 yrs. 4 mos. |
| Sterility reported | 58 cases = 80.6% | 32 yrs. 6 mos. |

FERTILITY AFTER TRACHELORRHAPHY

| | No. Cases Class A | Av. Age at Time of Op. |
|---|---|---|
| | 29 cases | 31 yrs. 2 mos. |
| Fertility reported | 11 cases = 38% | 31 yrs. 5 mos. |
| Sterility reported | 18 cases = 62% | 31 yrs. |

It is evident that the age of the patients in this series of cases offers no explanation of the results obtained. Why, then, should the occurrence of pregnancy be relatively twice as frequent after trachelorrhaphy as after

amputation of the cervix? Any plastic operation on the cervix necessarily results in the formation of a cicatrix, the extent of which is dependent upon the type of operation done and the manner in which healing follows; i.e., by primary union or by granulation. After amputation of the cervix, the cicatrix resulting occupies a plane perpendicular to the long axis of the cervix and must contract, from all directions, toward the cervical canal. This sphincter-like action of the contracting cicatrix may cause a complete closure of the cervical canal with retention of menstrual blood and hæmatometra. Several such cases have been reported and one example was seen in this clinic a few months ago. The occasional occurrence of extreme cases, such as these, indicates the possibility that the same process may occur to a lesser degree, in a large number of cases, there being developed a stenosis of the cervical canal, which though insufficient to cause hæmatometra, might render impregnation very unlikely. Considerable support is afforded such an assumption by the cases of amputation of the cervix reported. Of the 14 cases reporting fertility after this operation, 10 had two or more pregnancies. This result, taken into account with the fact that 80 per cent of Class A reported sterility, would indicate that cervical stenosis is of frequent occurrence in the sterile group, for if fertilization should ensue, in spite of the stenosis, the delivery following, even though premature, would dilate the cervical canal sufficiently to render a second pregnancy much more likely of occurrence. We would expect, then, a high percentage of sterile women and repeated pregnancies in the fertile group—precisely the results obtained.

Considerably more attention has been paid to the question of fertility following the operation of trachelorrhaphy than amputation of the cervix. During the twenty years following the introduction of Emmet's operation occasional comment has been made, the question at one time being the subject of a very caustic debate between Murphy (14) of Washington and Van de Warker (5) of Syracuse. Goodell (4), after operating on 169 cases, reported that he had heard of but 7 pregnancies following, and agreed with Murphy that sterility usually follows the operation of trachelorrhaphy. As no attempt was made to classify these cases, the results mean very little, and as has been previously indicated, almost all of the reports that have appeared bearing on this question are practically worthless, as no idea is given of the percentage of fertility in that group of cases, in which pregnancy might naturally be expected to follow. This is well illustrated in the following tabulation which embodies the results of most of the reports which have appeared.

FERTILITY AFTER TRACHELORRHAPHY

| | |
|---|---|
| Emmet (1) | Operated upon 600 cases; knew of "many" pregnancies. |
| Thomas (15) | Operated upon 102 cases; knew of "many" pregnancies. |
| Sutton (16) | Operated upon 60 cases; knew of "some" pregnancies. |
| Lusk (22) | Operated upon 300 cases; knew of "frequent" pregnancies. |
| Skene (23) | Operated upon 300 cases; knew of "many" pregnancies. |
| Goodell (4) | Operated upon 169 cases; knew of 7 pregnancies. |
| Mundé (17) | Operated upon 137 cases; knew of 13 pregnancies. |
| Jackson (18) | Operated upon 118 cases; knew of 9 pregnancies. |
| Lee (19) | Operated upon 100 cases; knew of 12 pregnancies. |
| Mann (20) | Operated upon 50 cases; knew of 4 pregnancies. |
| Wilson (21) | Operated upon 100 cases; knew of 4 pregnancies. |
| Baer (25) | heard from 21 cases; 6 became pregnant. |
| Montgomery (45) | heard from 30 cases; 5 became pregnant. |
| Beates (46) | heard from 23 cases; 2 became pregnant. |
| Ill (47) | heard from 44 cases; 12 became pregnant. |
| Van de Warker (5) | heard from 31 cases; 9 became pregnant |
| Janvrin (44) | heard from 15 cases; 3 became pregnant. |
| Johnson (48) | heard from 16 cases; 3 became pregnant. |
| Richardson (39) | heard from 17 cases; 3 became pregnant. |

A number of authors, more notably Goodell (4), Murphy (14), and Gehrung (24) concluded that sterility follows the operation as a general rule and attributed this sterility to the operation itself. Baer (25), although agreeing that sterility ordinarily follows, attributed it not to the operation but to the inflammatory condition of the cervix accom-

panying laceration and upon which the operation has no effect. Wells (2), however, in 1884, seems to voice the general consensus of opinion at that time. He writes, "When we take into consideration the number of abortions, the tendency to which all admit to be much increased by the lacerated and irritable state of the cervix, it is obvious that the operation materially swells the number of births at term, not only by enlarging the number of conceptions but also by lessening the number of abortions, so that we may safely say that Emmet's operation increases the fertility of those on whom it is performed."

It has been pointed out that the cicatrix following an amputation of the cervix occupies a plane perpendicular to the long axis of the cervix, and in contracting must narrow the cervical canal to some extent. The scar left by a trachelorrhaphy is rather linear than broad and occupies a position parallel with the long axis of the cervix. In contracting, it is inconceivable how such a cicatrix could narrow the cervical canal. Granting that sterility following a plastic operation on the cervix is due usually to a stenosis of the cervical canal, the relatively greater fertility of the patients after trachelorrhaphy than after amputation finds an easy explanation in the extent and situation of the scar tissue left by the operation. At any rate, it is safe to conclude that fertility is much more likely to follow trachelorrhaphy than amputation of the cervix.

### THE COURSE OF PREGNANCY AFTER AMPUTATION OF THE CERVIX AND TRACHELORRHAPHY

Audebert (26) and De Koninck (27) have insisted that amputation of the cervix exercises a marked influence on the course of subsequent pregnancies by causing very frequent abortion and premature delivery. Bernheim (28), reporting 49 cases, concluded that this is not true, but his evidence is overweighed by the work of Pescher (12), Pedobedoff (29), Guibout (7), Ducasse (30) and numerous others who have noticed this tendency to abortion following the operation. The comments to be found in the literature regarding the effect of trachelorrhaphy on the course of pregnancy are few but uniformly favorable, the general opinion being that the operation decreases the frequency of abortion.

In the following table, the influence of amputation of the cervix and trachelorrhaphy on the relative frequency of abortion before and after operation is shown, and demonstrates the superiority of the latter operation in this regard.

COURSE OF PREGNANCY AFTER AMPUTATION OF CERVIX

14 CASES

| | |
|---|---|
| Before operation, 52 pregnancies | |
| Delivery at term | 39, or 75% |
| Interrupted before term | 13, or 25% |
| After operation, 32 pregnancies | |
| Delivery at term | 14, or 45% |
| Interrupted before term | 17, or 55% |
| Now pregnant | 1 |

COURSE OF PREGNANCY AFTER TRACHELORRHAPHY

11 CASES

| | |
|---|---|
| Before operation, 73 pregnancies | |
| Delivery at term | 54, or 74% |
| Interrupted before term | 19, or 26% |
| After operation, 29 pregnancies | |
| Delivery at term | 21, or 72% |
| Interrupted before term | 8, or 28% |
| Now pregnant | 1 |

It will be seen that in each group of cases, 25 per cent of the pregnancies occurring before operation ended before term, this frequency possibly being attributable to the lacerated condition of the cervix. After operation, however, the frequency of abortion differs widely according to the type of operation performed. After amputation of the cervix, the liability to abortion is more than doubled while trachelorrhaphy has no effect upon the course of subsequent pregnancy.

Taking the cases singly, a number of interesting observations can be made corroborating the above conclusion:

PREGNANCIES AFTER AMPUTATION OF THE CERVIX

| | Delivery at term | Premature deliveries | Abortion[1] |
|---|---|---|---|
| Case I | 0 | 0 | 1 |
| Case II | 0 | 0 | 1 |
| Case III | 0 | 1 (8th mo.) | 0 |
| Case IV | 3 | 0 | 1 |
| Case V | 0 | 1 (7th mo.) | 0 |
| Case VI | 0 | 1 (8th mo.) | 2 |
| Case VII | 1 (now pregnant) | 0 | 0 |

[1] Including termination of pregnancy up to 6½ months.

| | | | |
|---|---|---|---|
| Case VIII... | 0 | 2 (7th mo. & 8th mo.) | 0 |
| Case IX..... | 2 | 1 (6½ mos.) | 0 |
| Case X..... | 2 | 0 | 3 |
| Case XI..... | 1 | 0 | 1 |
| Case XII.... | 2 | 0 | 0 |
| Case XIII... | 2 | 0 | 0 |
| Case XIV... | 1 | 0 | 2 |
| | 14=45% | 6=19% | 11=36% |

PREGNANCIES AFTER TRACHELORRHAPHY

| | Delivery at term | Permature deliveries | Abortion[1] |
|---|---|---|---|
| Case I..... | 4 | 0 | 3 |
| Case II..... | 1 | 0 | 0 |
| Case III..... | 2 | 0 | 1 |
| Case IV..... | 3 | 0 | 0 |
| Case V..... | 2 | 0 | 1 |
| Case VI..... | 1 | 0 | 0 |
| Case VII.... | 3 | 0 | 2 |
| Case VIII... | 1 | 0 | 0 |
| Case IX..... | 3 | 0 | 1 |
| Case X..... | 1 | 0 | 0 |
| Case XI..... | 0 (now pregnant) | 0 | 0 |
| | 21=72% | 0 | 8=28% |

In the first place, the relatively low percentage of full term deliveries after amputation of the cervix is apparent. Perhaps the most striking fact in the table, however, is the frequency with which premature delivery from the sixth to eighth month occurs after amputation of the cervix. In six instances out of 31, or in about 19 per cent of the pregnancies, premature delivery ensued, and in case 8, the only two pregnancies occurring after operation terminated by premature delivery, one at the seventh and one at the eighth month. On the other hand, not one of the 29 pregnancies occurring after trachelorrhaphy ended by premature delivery. Aside from the relatively greater frequency of abortion after amputation of the cervix, as compared with trachelorrhaphy, it is likewise of considerable interest to note that of the 14 cases in the first group (amputation of the cervix), only three cases, VII, XII and XIII, carried each pregnancy to full term, while after trachelorrhaphy, in 5 of the 11 cases, II, IV, VI, VIII and X, each pregnancy progressed to full term. It is evident that after amputation of the cervix, premature delivery is frequent as well as abortion, and that this objection does not apply to trachelorrhaphy.

[1]Including termination of pregnancy up to 6½ months.

THE CHARACTER OF LABOR AFTER AMPUTATION OF THE CERVIX AND TRACHELORRHAPHY

Post-operative cicatricial rigidity of the cervix has long been recognized as a cause of dystocia. Before the introduction of a plastic amputation of the cervix by Sims (3) in 1861, the occurrence of dystocia, in the occasional pregnancy following the crude procedures then in use, must have been almost invariable. With the use of plastic methods of amputation, securing primary union of the tissues, many authors claim that dystocia due to cicatricial rigidity has become almost unknown. Among these may be mentioned Pozzi (6), Pichevin (31), Doléris (13), Bernheim (28), Morisani (9), Ducasse (30) and Chalieux-Vivie (32). On the other hand, Guibout (7), Audebert (26), De Koninck (27), Lepage (33), Toledo (34), Martin (35), and many others have shown that dystocia after amputation of the cervix is not only of frequent occurrence but that it may reach any extreme, even causing rupture of the uterus.

After trachelorrhaphy, dystocia has evidently but seldom been met with, for references to its occurrence are very scarce. Murphy (14), who could find nothing to recommend the operation, concluded (from 11 cases collected from literature) that the character of labor is unusually severe and protracted. In this opinion, however, he is quite alone. Goodell (4), Mundé (17), Hanks (36), Lee (19), Githens (37), Ford (38), Jackson (18), Mann (20), Lusk (23), Wilson (21), Richardson (39), Skene (23), Jenks (40), and Scott (41) have all expressed themselves to the effect that trachelorrhaphy is without influence upon the character of subsequent parturition. A study of the cases from this clinic seems to corroborate the general consensus of opinion regarding the influence of both amputation of the cervix and trachelorrhaphy in this respect.

DELIVERY OF THE FIRST CHILD AFTER AMPUTATION OF THE CERVIX

| | Before operation | Age[2] yrs. | Character of first labor after operation |
|---|---|---|---|
| Case IV | para II | 27 | Difficult labor, full term |
| Case V | para VIII | 36 | Premature delivery 7th mo. Difficult labor |

[2] At the time of the first delivery following operation.

| | | | |
|---|---|---|---|
| Case VI | para II | 26 | Premature delivery 8th mo. Easy labor |
| Case VII | para I | 28 | Difficult labor, full term |
| Case VIII | para V | 37 | Premature delivery 8th mo. Easy labor |
| Case IX | para I | 32 | Difficult labor, full term |
| Case X | para II | 27 | Easy labor, full term |
| Case XI | para V | 29 | Easy labor, full term |
| Case XII | para I | 37 | Difficult labor, full term |
| Case XIII | para III | 35 | Difficult labor, full term |
| Case XIV | para II | 26 | Difficult labor, full term |

DELIVERY OF THE FIRST CHILD AFTER TRACHELORRHAPHY

| | Before operation | Age[1] yrs. | Character of first labor after operation |
|---|---|---|---|
| Case I | para I | 22 | Prolonged 18 hours. Full term |
| Case II | para IV | 42 | Easy labor. Full term |
| Case III | para VII | 37 | Difficult labor. Full term |
| Case IV | para VIII | 34 | Easy labor. Full term |
| Case V | para VII | 40 | Easy labor. Full term |
| Case VI | para IV | 33 | Easy labor. Full term |
| Case VII | para VII | 41 | Easy labor. Full term |
| Case VIII | para VII | 37 | Easy labor. Full term |
| Case IX | para I | 32 | Easy labor. Full term |
| Case X | para II | 23 | Easy labor. Full term |
| Case XI | para VI | | Now pregnant (7 mos.) |

A glance at the above tabulation is sufficient to offer convincing evidence of the great difference in the character of the first labor after the two operations. Following amputation of the cervix, the first labor was difficult in 7 of the 11 cases, in one instance (Case V), the delivery of a seven month's child being attended with considerable dystocia. In striking contrast to this result is the fact that 8 of the 10 cases of full-term pregnancy following trachelorrhaphy had easy labors. In only one case was labor difficult, and in one other, prolonged to 18 hours. Reamy (42) attended 6 of his cases at the first labor after trachelorrhaphy. In 2 cases, dilatation of the cervix was rather slow, but each of 15 other cases heard from had normal labors. Hanks (36), Githens (37), Ford (38), Jackson (18), Mann (20), Wilson (21), Lee (19), Richardson (39), Harrison (43), and Janvrin (44) have reported a total of 34 cases seen in labor some time after trachelorrhaphy, in 29 of which labor was normal, parturition in the remaining 5 cases being described as difficult or prolonged.

The question of relaceration of the cervix during the first labor after operation has been the subject of considerable discussion. In only one of Reamy's cases was the cervix relacerated. Mundé reported relaceration in about 20 per cent of his cases. Wells, reporting 77 cases of trachelorrhaphy collected from the literature, found that in 62 cases, or 80 per cent, the cervix was not lacerated during the first labor after operation, while of the remaining 15 cases, 8 were but slightly lacerated. Unfortunately, a reliable report on the cases from this clinic, regarding this point, could not be obtained.

Whether relaceration of the cervix occurs commonly or not, we may at least safely conclude that dystocia, due to cicatricial rigidity of the cervix, is common after amputation, while following trachelorrhaphy, is unusual.

I wish to express my thanks to Dr. Howard A. Kelly, from whose clinic in the Johns Hopkins Hospital these cases are reported, and to Dr. Wm. W. Russell, my gratitude for his interest in the work and the many valuable suggestions he has offered.

CONCLUSIONS

1. The presence of a marked endocervicitis should be considered as a contra-indication to the performance of trachelorrhaphy.

2. Although serious post-operative hæmorrhage is not infrequent after amputation of the cervix (5 per cent), this accident is very uncommon after trachelorrhaphy.

3. The influence of trachelorrhaphy in improving the general condition of the patient is, in properly selected cases, quite as marked as that of amputation of the cervix. In each instance about 90 per cent of the patients report improvement in the general health.

4. Although trachelorrhaphy may render a mild endocervicitis more amenable to treatment, it can not be considered, like amputation of the cervix, as a curative measure for this condition.

5. Laceration of the cervix is a frequent cause of dysmenorrhœa in multiparæ, and its removal by either amputation of the cervix or trachelorrhaphy is followed by the disappearance or amelioration of menstrual pain in over 60 per cent of cases.

6. Fertility is much more likely to follow trachelorrhaphy than amputation of the cervix.

[1]At the time of the first delivery following operation.

7. After amputation of the cervix, the incidence of abortion and premature delivery is greatly increased, while trachelorrhaphy has no effect upon the course of subsequent pregnancy.

8. Labor after amputation of the cervix is usually difficult, while after trachelorrhaphy it is almost always normal.

9. Amputation of the cervix is an operation to be avoided in women in the child-bearing period until all other therapeutic means have been exhausted.

10. Trachelorrhaphy has a therapeutic efficiency, in properly selected cases, quite as high as amputation of the cervix, and, having no influence upon the subsequent marital history of the patient, is the operation of choice for women in the child-bearing period.

## BIBLIOGRAPHY


1. EMMET. Am. J. Obst., N. Y., 1874–5, vii, 442; Am. Pract., 1877, xv, 1; Tr. Am. Gynec. Soc., 1897, 186; Am. J. Obst., N. Y., 1897, p. 858.
2. WELLS. Am. J. Obst., N. Y., 1884, xvii, 561.
3. SIMS. Am. J. Obst., N. Y., 1874–5, vii, 455; Tr. Med. Soc., N. Y., 1861.
4. GOODELL. Am. J. Obst., N. Y., 1882, xv, 121.
5. VAN DE WARKER. Am. J. Obst., N. Y., 1883, xvi, 673.
6. POZZI. Traité de gynéc., Paris, 1892; Bull. et mém. Soc. de chir., 1893, p. 93.
7. GUIBOUT. Thesis, Paris, 1900, No. 341.
8. LA TORRE. Arch. ital. di ginec., Napoli, 1898, p. 209; XIII Cong. Internat. de Méd., Par., 1900, p. 395.
9. MORISANI. XIII Cong. Internat. de Méd., Par., 1900.
10. MANGIN. Nouv. arch. d'obst. et de gynéc., 1895.
11. DUPONNOIS. Thesis, Montpelier, 1901.
12. PESCHER. Thesis, Paris, 1892.
13. DOLÉRIS. Gynécologie, Par., 1900, p. 132; Nouv. arch. d'obst. et de gynéc., Paris, 1890.
14. MURPHY. Am. J. Obst., N. Y., 1884, xvii, 623 Am. J. Obst., 1883, xvi, 28.
15. THOMAS. Quoted by Johnson, J. Am. M. Ass., 1884, p. 6.
16. SUTTON. Quoted by Johnson, J. Am. M. Ass., 1884, p. 6.
17. MUNDÉ. Quoted by Wells, Am. J. Obst., N. Y., 1884, p. 561.
18. JACKSON. Quoted by Johnson, J. Am. M. Ass., 1884, p. 6.
19. LEE. Quoted by Johnson, J. Am. M. Ass., 1884, p. 6.
20. MANN. Quoted by Johnson, J. Am. M. Ass., 1884, p. 6.
21. WILSON. Quoted by Johnson, J. Am. M. Ass., 1884, p. 6.
22. LUSK. Quoted by Johnson, J. Am. M. Ass., 1884, p. 6.
23. SKENE. Quoted by Johnson, J. Am. M. Ass., 1884, p. 6.
24. GEHRUNG. St. Louis Cour. Med., ix, 534.
25. BAER. Med. News, Phila., 1883, xlii, 225, 724; Tr. Obst. Soc., Phila., 1883, Feb.
26. AUDEBERT. Ann. de gynéc et d'obst., Par., 1898, p. 20.
27. DE KONINCK. Rev. méd., Louvain, 1897–8, p. 389.
28. BERNHEIM. Thesis, Paris, 1899.
29. PEDOBEDOFF. Thesis, Paris, 1905.
30. DUCASSE. Thesis, Paris, 1889.
31. PICHEVIN. Nouv. arch. d'obst. et de gynéc., 1891.
32. CHALIEUX-VIVIE. Ann. de gynéc et d'obst., 1899, p. 329; Rev. mens. de gynéc., obst. et pediat., Bordeaux, 1900, p. 405.
33. LEPAGE. Rev. gén. de clin. et thérap., Par., 1903, p. 582; Bull. méd., Par., 1903, p. 947.
34. TOLEDO. Thesis, Paris, 1890.
35. MARTIN. Thesis, Lyon, 1905.
36. HANKS. Am. J. Obst., N. Y., xvi.
37. GITHENS. Tr. Obst. Soc., Phila., 1883, Feb.
38. FORD. Obst. Gaz., Cincin., vi.
39. RICHARDSON. Quoted by Johnson, J. Am. M. Ass., 1884, p. 6.
40. JENKS. Quoted by Johnson, J. Am. M. Ass., 1884. p. 6.
41. SCOTT. Quoted by Johnson, J. Am. M. Ass., 1884, p. 6.
42. REAMY. J. Am. M. Ass., 1884, p. 315.
43. HARRISON. Virginia M. Monthly, i, 526.
44. JANVRIN. Am. J. Obst., N. Y., xiii.
45. MONTGOMERY. Tr. Obst. Soc., Phila., 1883, Feb.
46. BEATES. Tr. Obst. Soc., Phila., 1883, Feb.
47. ILL. Tr. Med. Soc., N. J., 1882, p. 157.
48. JOHNSON. J. Am. M. Ass., 1884, p. 6; Thesis, A. G. Newell, 12 p., 4°, 1884.

# SYPHILIS OF BONES AND JOINTS

## With a Report of Ten Cases

By SAMUEL W. BOORSTEIN, M. D., New York City
Orthopedic Assistant in Montefiore Home and Hospital, Clinical Assistant in Orthopedic Department of Vanderbilt Clinic

THOUGH syphilis of the bones and joints is not seen in our orthopedic clinics as often as the tubercular affections, still it is said with assurance that more patients are afflicted with syphilis of the bones and joints than are reported in the literature. Many cases of bone syphilis are unrecognized or diagnosed as tubercular. The reason is merely that we have not enough signs as yet by which to recognize this affection early.

Even if we could succeed in obtaining specimens in an early stage, we would not easily verify the diagnosis for the reason that the histologists give us no definite histological findings by which to differentiate this condition from other similar ones.

It is, therefore, of the utmost importance that every case of syphilitic disease brought to the observation of the orthopedist should be placed in the medical literature, and perhaps in this way some cases may be diagnosed early and proper treatment may be instituted. The prognosis of the luetic attack of the bones and joints is much more favorable than general syphilis and early treatment is therefore of special importance.

This justifies the writer's reports of those cases that came to his attention during the last year. Since he was fortunate enough to have patients showing different varieties of bone and joint syphilis, it will not be out of place to give a short résumé of the symptoms and the signs known up to recent date concerning the changes in those tissues.

### A. BONE LESIONS

Bone lesions occur commonly in the hereditary form and in the tertiary stage of the acquired disease.

I. *Hereditary syphilis.* (*a*) Early forms of hereditary syphilis occur soon after birth. It takes the form of an osteochondritis and involves several bones. The lower extremities are the first ones to be attacked. Gelatinous masses are formed beneath the periosteum and at the epiphyseal line, producing occasionally true fractures of the shaft or separation of the epiphysis. There is a thickening of the periosteum and bone cortex. The cartilage is also involved, namely, there is a multiplication and irregularity of the cartilage cells of the ossifying layer and premature calcification. Necrosis may be present, as shown by a zone of hard, dry, yellow substance in the ossifying layer. The newly formed bone is softened and replaced by granulation tissue. If the disease is progressive, ulceration and suppuration may follow. The cartilage may be destroyed and growth stopped. The fact that it involves the diaphysis sparing the joint differentiates this condition from a diffused tuberculosis. The absence of high temperature and comparative mildness of the symptoms in proportion to the large area of bone involvement differentiates it from osteomyelitis. On account of the swelling of the soft parts, the condition simulates true joint lesion, but a careful examination will elicit the fact that the joint is usually free. The cartilages of the ribs are also commonly involved.

Case 1. M. S., female, age 2½ years, born in the United States of Italian parents. Mother brought the baby to Vanderbilt Clinic, complaining that the child never walked. The child had no night cries and no fever at any time (?). Examination showed a very undersized child. The upper extremities and the ribs showed deformities simulating rickets. The child had no teeth whatever. Many glands were enlarged. The spinal motions free. The left hip showed muscular spasm. The thigh was kept in a flexed position at an angle of 110°. The spasm could be easily overcome. There was very little limitation of motion in the hip. At the junction of the upper and middle third of the thigh and the outer surface there was a marked swelling with an opening toward the surface. The swelling was not red. A profuse thin greenish discharge could be pressed out from the tumor by the slightest pressure. Mother related that the swelling occurred about one

year ago and at the same time the discharge started. This was really the first thing that called mother's attention and induced her to consult her family physician. The discharge could not be stopped by him in spite of all his efforts by ointments and dressings. The fact that the child was unable to walk grieved the mother and she came to the clinic.

On further examination it was found that the other thigh had also some swelling of the femur but no discharge and also some limitation of motion in the hip. As the mother was a foreigner and ignorant, it was hard to obtain a satisfactory history of syphilis but it seemed that she had had two or three miscarriages.

The patient was examined by Prof. V. P. Gibney, who diagnosed it as hereditary syphilis. Unfortunately the case disappeared from observation and we could not take radiographs, Wassermann and other syphilitic tests, but the diagnosis of such a reliable diagnostician as Gibney can be relied on. The clinical facts here given show also the real nature of the case. We can easily see that the main lesion was at the epiphyseal junction of both femora. There probably was necrosis and suppuration, which opened afterwards at the surface.

(*b*) In late hereditary syphilis cortical thickening and calcareous deposits beneath the periosteum are common, giving rise to sabre-shaped tibiæ and tender fusiform swellings along the shafts of the long bones. Frequently small areas of rarefaction with a cap of dense bone raised above the line of the normal shaft are seen in the skiagraph. These have been called "bone blisters." Beneath the periosteum can frequently be found a calcareous deposit which appears as a faint area bulging along the shaft and resembling early callus. It is confused usually with early osteomyelitis proper or osteomyelitis serosa or periostitis albuminosa or certain cases of giant-celled and periosteal sarcoma. An important aid in the diagnosis of hereditary syphilis is the presence of keratitis.

CASE 2. D. J., male, age 19, born in the United States, motorman. Family history: Parents alive and well, but father and mother live separated. Both parents denied syphilis (according to the patient's report at his second visit). Patient does not know whether his mother had miscarriages or not. Personal history: Has always been healthy, and does not remember ever having been sick. Denies ever having had sexual intercourse. Does not use alcoholic beverages. Present illness dates back six months, when patient noticed a swelling on the left tibia on inner surface. Does not remember any trauma that might have produced it. Had no pain whatever when ailment started. About one month later he noticed a small opening at the middle of the tibia. A small amount of blood exuded causing no pain whatsoever. About the same time a similar opening and bloody discharge occurred at the right tibia. Both openings closed. Lately the swelling of the left tibia has been increasing, giving rise to slight pain and making the process of walking uncomfortable, but had no pain at night. Came to the Vanderbilt Clinic in January, 1913.

Physical examination: The young man was robust and well built; slight saddle-shaped nose. Teeth showed no Hutchinson's peculiarities. The cervical, axillary, trochlear and inguinal glands were enlarged. There was a marked irregular swelling on the inner surface of the left tibia extending from inner tuberosity to about the middle of the tibia where a small opening covered by a scab was observed. This tumor was not tender. The joint was freely movable. No other bone was involved. The skiagraph (Fig. 1) shows that the periosteum is very thick and there is dense bone raised above the line of the normal shaft. The faint area bulging along the shaft beneath the periosteum is probably calcareous deposit. The Wassermann reaction was very strongly positive (four pluses). This case is probably a late hereditary syphilis, as he had no symptoms of first and secondary stages.

II. *Acquired syphilis.* The affection of the bone usually occurs in the tertiary stage. The pathological findings are the same as in late hereditary form. In acquired syphilis we have also bone gummata in the third stage, of which there are two forms, (1) superficial, and (2) deep.

1. The superficial gummata occur between the bone and the periosteum causing ulcerations of the cortex. The gummata may join each other in a stellate manner. Tousey points out the following radiographic findings in superficial gummata — on one side of the bone, the corticals are thinned by irregular patches of rarefaction. Its uniform outline can no longer be traced. The periosteum is intact over a swelling which shows more or less ossification. At the extreme margins it is clearly noticeable that the swelling is a periosteal one, as the bony contour is preserved with the less dense shadow of the periosteum springing away from it.

2. The deep gummata occur in any part of the bone and may cause fracture.

Patient may have diffused syphilitic osteomyelitis which does not show on the radiograph. Syphilis may produce vertebral lesions and simulate Pott's disease.

B. JOINT LESIONS

It is an established fact that syphilis plays an important part in causing arthritic symptoms though frequently not diagnosticated.

*I. Hereditary joint lesions.* Von Hippel found that 56 per cent of hereditary syphilitics show joint lesions. Kaufman in "Special Pathology" asserts that they usually take the form of exudative arthritis caused by a neighboring gumma or an osteochondritis breaking through the epiphysis into the joint. Kirmisson and Jacobson classified the hereditary forms of syphilitic joint disease as follows: 1. A single osteo-arthropathy beginning insidiously with severe and persistent nocturnal bone pain. One of the bony extremities enlarges and the condition simulates tumor albus. Hyperostoses may be present. The limitation of motion is usually mechanical. 2. The important feature may be only hydrops. The synovia is thickened locally or diffused but there are no bony changes. The fluid of the joint is markedly increased. 3. Deforming osteo-arthropathy where the epiphyses are irregular.

*II. Acquired syphilitic joint lesions.* The primary stage may be accompanied by acute fibrile arthritis (Goldthwait, Osgood, and Painter). In the secondary stage we usually have (*a*) simple arthralgia without objective symptoms. Pain is distinctly localized over tendons and ligaments and is worse at night, probably due to pressure from distended veins. This form very rapidly yields to mercurial treatment. (*b*) Subacute arthritis characterized by slight effusion and swelling with white or only slightly reddened joints. This form is rare. (*c*) Hydrops, i. e., where the increase of the fluid is the first symptom. The course is slow and insidious. The knee joint is mainly involved.

In tertiary syphilis the joint together with the bone or the joint itself may be involved. We have therefore two types: (*a*) Synovial type, where a marked effusion is followed by a gradual onset. The pain is sharp. This form is usually monoarticular and mostly affects the knee. Motion of the joint is normal. Considerable muscular atrophy accompanies it. (*b*) Bony type, in which we find marked hyperostosis. The extremities of the bones become enlarged, smooth and rounded. Pain is greater at night. May result in ankylosis or great relaxation and hypermobility. Gummata may also be present in the arthritic lesion. We have two types of articular gumma: (*a*) periosteal, or capsular, which spreads into the articulation and produces villi containing minute gummata. This form usually produces destructive changes in the cartilage and the bone. (*b*) Primary osteal form extending into the joint producing destructive changes in the bone and the cartilage and may result in suppuration and ankylosis.

CASE 3. N. P., female, married, age 22, born in the United States of Irish parents. Family history is negative. Personal, has always been well. Married at seventeen, husband was twenty-one, has three healthy children and has had no miscarriages. Husband denies syphilis. Previous history: Had a cataract since the age of five.

Present illness dates back one and a half years, when patient began to complain of severe pain in the left knee. The knee became swollen but not red. In four weeks the motion of the joint became limited, so that patient could not extend the leg more than to an angle of 135°. The pain was more severe at night. Patient gave a history of trauma six months previous to the occurrence of the swelling but it really had nothing to do with the disease. This trauma occurred in a railroad accident and she attributed the knee affection as a sequence to it while bringing action against the company. The truth of the writer's assumption that the knee affection had nothing to do with the injury is verified by the fact that on taking her history for the first time she did not mention anything about the injury. It was only after consulting her legal attorney that she mentioned the injury. We mention this for the reason that on frequent occasions one may attribute such an attack to the trauma and not think at all of syphilis. She came to the Clinic on July 26, 1912.

The physical examination showed a healthy, robust young woman. Station: No Romberg. Gait: Walked with a limp, bending toward the left side. Eyes reacted normally to light and accommodation. Cataract on left eye. Some glands were palpable. The left knee was very large. The outline of the knee was abolished. Patella freely movable, though slight tenderness elicited on touch. Motion revealed pain and patient could not extend knee more than to an angle of 135°. No grating in the joint. No rice bodies. No pain on jarring; not relieved much by traction. A radiograph (Fig. 2) was taken at that time, which showed thickening of internal border of the periosteum of femur, irregular outline, i.e., raised in some places. The patella was removed from femur. No destruction of bone, no rarefaction. No fracture visible. The synovial membrane was not shown very clearly.

Fig. 1. Case 2. February 13, 1913. A, left leg. Note the thickening of the periosteum. a, dense bone raised above the line of the normal shaft; b, faint area bulging along the shaft of the periosteum is probably calcareous deposit. Unfortunately the osteo-chondreal line did not come out well to show whether there is the characteristic osteo-chondritis. B, right leg; no thickening of periosteum.

In considering the diagnosis, tuberculosis could be ruled out at once, as an affection lasting for a year and a half would show more symptoms and more destruction of bone. Osteomyelitis was eliminated

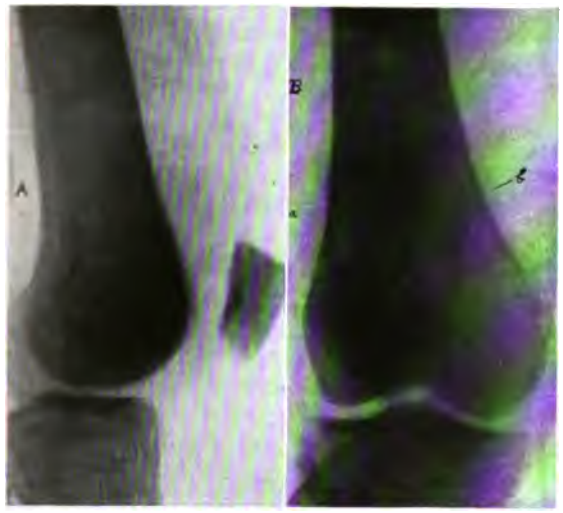


Fig. 2. Case 3. Before starting any treatment. September 27, 1912. A, lateral view; B, antero-posterior view; a, thickening of periosteum; b, irregular outline of periosteum. There is no destruction, no rarefaction, nor fracture. Note marked separation of patella from femur.

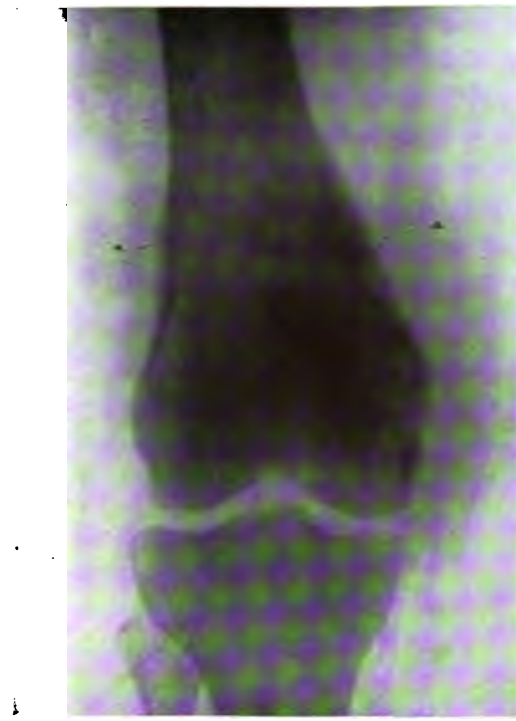


Fig. 3. Case 3. February 3, 1913. The periosteum is markedly thickened on both sides, especially at a, though the pain was markedly diminished. There is no destruction. The cartilage is almost normal.

on account of absence of fever and acute symptoms. Chronic synovitis — shows no radiographic change. of the bones. Sarcoma has no increase of fluids Gonorrhœal arthritis — by the comparative mild symptoms. We therefore believed that it was probably a syphilitic joint. The patient had been taking some medicine prescribed by a private physician, but we could not ascertain whether it was anti-syphilitic treatment. We did not therefore take a Wassermann test. Meanwhile we immobilized the knee in a removable plaster cast and advised the use of Bier's hyperæmia for two to four hours daily. Patient used also applications of hot and cold douches before retiring. After a few months' treatment the swelling was markedly diminished. Pain became less, especially during the night. Could bring the leg up almost to a straight line with the thigh. Tenderness was less. Was told to continue the treatment with the addition of exercises for ten to fifteen minutes twice a day. The improvement continued. We then took a Wassermann test which was very strongly positive (four pluses). The radiograph at that time (Fig. 3) showed the following findings: The periosteum more thickened on both borders of the femur, more irregular but no destruction or rarefaction of the bones found. Joint is clear.

Fig. 4.

Fig. 5.

Fig. 4. Case 4. Left elbow-joint, lateral view shows considerable amount of periosteal proliferation involving the head and upper two inches of shaft of the radius. Area of absorption (a) present. Olecranon process is also involved.

Fig. 5. Case 4. Antero-posterior view of same joint as Fig. 4. The thickened area of the periosteum and the absorption is more clearly shown.

On Feb. 21, 1913, patient received an intravenous injection of neosalvarsan (0.9 gm.). The pains stopped entirely within three days. On Feb. 26, 1913, patient was put on mixed treatment. On March 17, 1913, patient received another injection of neosalvarsan (0.9 gm.) and was still kept on the mixed treatment. At present the patient has no pain whatever, walks perfectly well. No tenderness. Swelling has almost entirely disappeared. This case shows distinctly how easily the diagnosis of syphilis can be overlooked. This case belonged to "bony type of tertiary syphilis."

CASE 4. K. E., male, single, age 32, born in the United States, Hebrew, salesman. Previous history gives a distinct history of syphilis five years ago. He was treated with three injections of salvarsan followed by mercury but for a short time only. Present illness: For the last six months patient has been suffering from marked pain in the left elbow joint. The pain is markedly increased on motion but does not become more acute at night. For the last month the elbow-joint is markedly swollen. Was observed by the writer for the first time on May 15, 1913. Physical examination showed a markedly swollen elbow-joint, no redness. Cannot flex the elbow beyond the angle of 100°. Extension only up to an angle of 135°. Pronation is markedly limited while supination is slightly limited. Keeps the forearm midway between supination and pronation. The joint is very tender to the touch. The tibiæ show marked rough surfaces. General symptoms of syphilis are present. Mucous

Fig. 6.

Fig. 7.

Fig. 6. Case 5. Note the increase of the joint and the loss of contour. Patient had to support himself while the picture was taken.

Fig. 7. Case 5. The hyperextension is clearly brought out.

membranes of nose and throat are diseased. The radiograph (Figs. 4 and 5) shows marked thickening of the upper extremities of ulna and radius. The olecranon and coronoid processes markedly involved. A small area of absorption is seen at the radius. The radiograph of the tibiæ brings out especially the marked thickening of the periosteum. This case presents therefore the bony type of joint lesion of tertiary stage.[1]

## DIAGNOSIS OF SYPHILIS OF BONES AND JOINTS

As we have seen above, there is no definite sign to recognize this affection. A history of hereditary taint and of venereal lesion or secondary manifestation of the disease are the most important aids in verifying the disease. The Wassermann reaction should not be omitted. Radiographic findings are of great help. The thickening of the perios-

[1] Since writing this article patient has received an intravenous injection of neosalvarsan (0.9 gm.) followed by subcutaneous injections of hydrargyr. salicyl. (0.06 gm.) every fifth day and large doses of KI internally. The joint was immobilized for part of the day while for two to three hours daily some exercises prescribed. Within one month, pain and swelling have entirely disappeared. Could extend the forearm to a straight line. Supination and pronation — free. Flexion up to an angle of 80°.

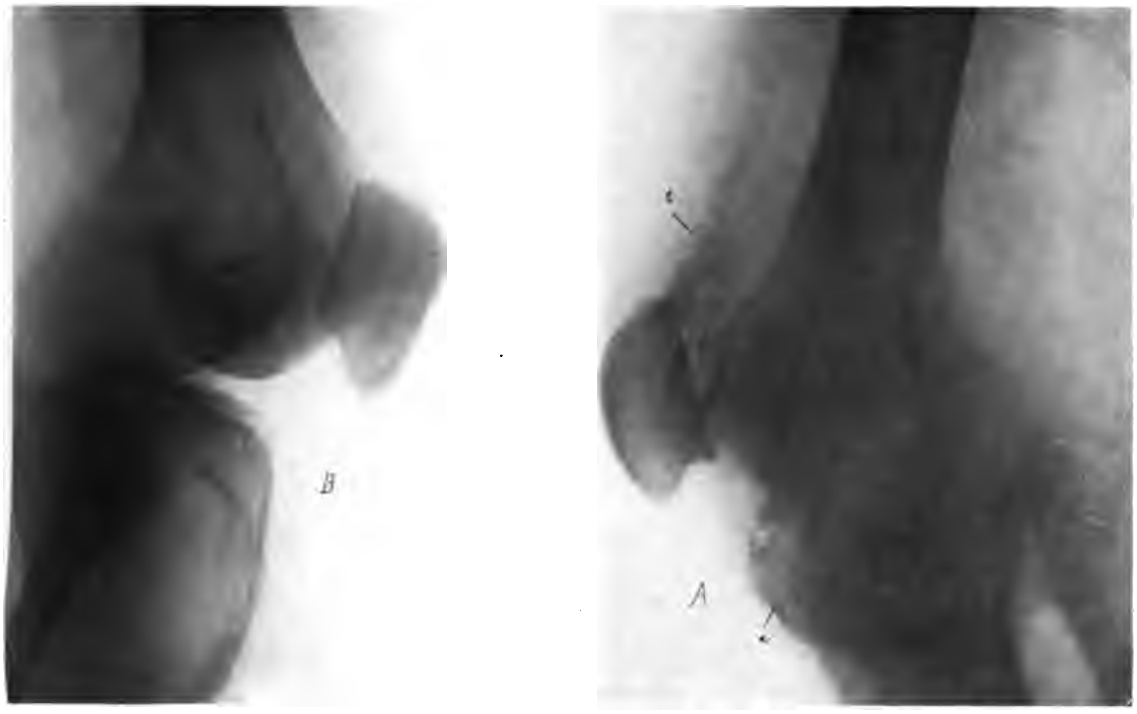


Fig. 8. Case 5. A, the left knee joint; B, the right knee joint; a, destruction of the head of the tibia is seen; b, the proliferation and hypertrophy of the bone occurring at the same time is noticeable.

teum is of marked significance. The osteochondritis is characteristic of hereditary syphilis.

We must remember that syphilis shows a productive osteitis while tuberculosis usually shows a rarefying osteitis. In some cases it is hard to distinguish it in the radiograph from acute osteomyelitis or healed tuberculosis.

*Prognosis* is good as far as relief from pain and restoration of function are concerned but changes in bone structure will still be found in the radiograph on future examinations. The relief from pain in Case 3 following the immobilization was remarkable.

*Treatment.* Strong antiluetic measures should be instituted. We are accustomed to give two or three injections of salvarsan or neosalvarsan in an interval of three weeks, followed by intramuscular injections of mercury salicylate (0.06 gm.) every five days, while potassium iodide is pushed to the limit. In the acute stage immobilization of the joint for brief periods is advisable.

### C. ALLIED CONDITIONS TO SYPHILIS

Whenever one writes or studies about syphilitic bone lesions, he at once associates with it Charcot's joint and other tabetic conditions, as "syphilis is by far the most important factor in causing tabes dorsalis" (Dana). We shall therefore devote our attention also to Charcot's joints. Charcot's disease is a destructive osteo-arthritis. Its pathology resembles hypertrophic arthritis. The cartilages degenerate and are worn away by movements of the limb together with the underlying bone. There is also in addition an exaggeration and irregular formation of cartilage and bone about the periphery of the joint. Synovial membrane is hypertrophied and occasionally there are calcareous deposits in the meshes of the membrane. There is an increase in joint contents. The newly formed bone is soft and spongy.

The symptoms of Charcot's joint are: (*a*) swelling which extends to surrounding parts and is due to effusion; (*b*) laxity of the ligaments and deformity soon following; (*c*)

Fig. 9. Case 6. Both knees. The destruction of the bone is visible especially at the extremity of the femur. Some hypertrophy can also be noticed.

no local pain or sensitiveness but weakness and distortion of the limb. The joint most commonly involved is the knee.

CASE 5. F. L. P., male, single, age fifty-four, born in the United States, patient in Montefiore Home. Family history, negative. Personal: Patient admits having had several attacks of gonorrhœa. Had a chancre thirty-four years ago followed by secondary syphilitic symptoms; had also some bone pains at the same time. Present illness: For the last two and a half years patient has had tabetic symptoms. About the same time patient noticed that the left knee became weaker and could not bear any weight. Had no pain whatever at the knee. The joint became markedly swollen. The weakness in the knee had increased to such an extent that patient was forced to use crutches during the last year. Physical examination showed Argyll-Robertson's pupils and other signs of tabes. The left knee (Figs. 6 and 7) is enlarged, outline of the joint is changed. There is a great deal of hypertrophic osteitis. A good deal of crepitus and loose bodies are evident. Patella is mobile. Under surface of patella is smooth. No redness or tenderness of the joint. Measurements: Circumference of the right

Fig. 10. Case 7. Showing the marked genu valgum.

knee at the middle of patella is 13¾ inches while the left is 16 inches. The circumference of the right calf at its greatest volume is 13¾ inches while the left calf is 14 inches. Motion of the joint: Flexion of the knee is not limited. The knee can be hyperextended to fifteen degrees beyond straight line. Lateral motion is increased. Abduction, fifteen degrees, and adduction, fifteen degrees to the side of the middle line. Wassermann Test: the blood is negative while the cerebrospinal fluid gives a strongly positive Wassermann, an excess of globulin, excess of albumin. There are 152 cells to the cmm. in the cerebrospinal fluid. The radiograph (Fig. 8) shows the marked destruction of the bone together with the hypertrophic changes.

CASE 6. A. S., female, widow, age 52, born in Russia, Hebrew. Family history negative. Personal history: Had one miscarriage and no other children. Does not know the cause of the death of her husband. Present illness: For the last four years patient has been complaining of marked weakness in both feet. No other complaints.

Physical examination showed many signs of tabes. There is a considerable emaciation of muscles of both legs. Right knee: Contour of the joint changed; patella freely movable; loose bodies in the joint. Hyperextension and lateral motion in the knee is permitted. Hyperextension to an angle of fifteen degrees. Abduction also to an angle of fifteen degrees. Left knee showed also presence of loose bodies in the joint. Hyperextension of the

Fig. 11. Fig. 12.

Fig. 11. Case 7. Antero-posterior view showing how the inner extremity is thickened producing the genu valgum.

Fig. 12. Case 7. The hypertrophy at the lower extremity of the femur, patella, and the upper extremity of the tibia is apparent.

Fig. 13. Case 8. Destruction of the body of the second cervical vertebra is seen at (a) which gave the pressure symptoms.

knee to an angle of forty degrees. Abduction to an angle of twenty degrees. Measurements: Circumference of right leg below patella, 10 inches; left, 12 inches. Circumference of right thigh at three inches above the lower border of patella 11¼ inches, while left is 11¾ inches. Right calf at its greatest circumference is 8½ inches; left calf, 9½ inches. Both hip joints are lax. Wassermann, negative. The radiographic findings (Fig. 9) marked destruction of the bones together with hypertrophy.

CASE 7. J. J., male, widower, age seventy-seven, born in Germany. Previous history: Had gonorrhœa and bubo at twenty. He does not know whether he has had a chancre. Has had tabes for the last twelve years. For the last nine years has had marked weakness of left knee and a gradual production of knock-knee.

Physical examination: Has many signs of tabes with marked genu valgum of left knee (Fig. 10). There is an excessive lateral motion of the knee permitting 10° to each side. The knee can be slightly overextended. There are rice bodies palpable in the knee, especially under the patella. Palpation elicits some disorganization of the joint tissues. Marked varicose veins present on left leg. The right knee presents only very slight genu valgum, otherwise it is normal. The radiograph (Figs. 11 and 12) shows the destruction and hypertrophy of the lower extremity of the femur at the inner tuberosity. The tibia and patella show also destruction.

*Vertebral osteo-arthropathy.* Besides the knee involvement we have vertebral osteo-arthropathy. S. Fosdick Jones, in an article "Vertebral Osteo-arthropathy,"[1] gives a careful review of the literature. He found only thirty cases reported. He adds two of his own. This shows how this condition is often overlooked, as there were surely more than thirty-two cases since 1874. He maintains that most observers have found that the vertebræ were compressed and reduced in height and enlarged laterally. The intervertebral discs were thickened and ossified. The symptoms are usually those of pressure of the enlarged bone when pressure of the cord is produced.

CASE 8. W. G., male, age 55, married, born in Germany, patient of the Montefiore Home. Previous history: Had a chancre at the age of twenty-two. No secondary symptoms. Present illness dates back two years when patient began to complain of inability to use freely his lower extremities and of paræsthesis. The upper extremities were also markedly weakened. When admitted to the home, patient was bed-ridden. Physical examination revealed some indefinite signs of tabes. Marked spasm of the muscles of neck so that patient was unable to rotate head laterally. Flexion fair. Could not extend the head backward. On supporting the chin and lifting up the head the spasm was

[1] Am. J. Orthop. Surg., 1913, x.

Fig. 14. Case 9. Showing the marked angular kyphotic protrusion at the lumbar region.

markedly diminished. Patient had no pain in the neck whatever. Neurological status showed absence of knee-jerks; abdominal reflexes diminished. Babinski, present. No ankle clonus. Sensation, pain and tactile, normal; delayed thermal sensation.

The radiograph (Fig. 13) showed the destruction of the body of the second cervical vertebra. Wassermann was positive. The diagnosis of vertebral osteo-arthropathy with pressure on the cord was made. The patient was put in a plaster jacket with a jury mast. The paræsthesis of the lower extremities disappeared in one or two days. Within three weeks patient was able to walk. Patient lived about two years longer, wearing a corset all the time. He finally died from chronic nephritis. Unfortunately we were unable to obtain permission for an autopsy.

CASE 9.[1] J. F., age 53, male, born in Hungary, Hebrew, patient of Montefiore Home. Previous history: Had gonorrhœa and chancre at twenty-five. Has had tabes for the last eighteen years. In 1900 he noticed a marked kyphosis of the lower spinal region, had no pain or tenderness of the spine. He was seen by Charcot, who diagnosed it as vertebral osteo-arthropathy. Since 1904 patient has been unable to walk and has been confined to bed. Physical examination: Patient has all the definite signs of tabes. Wassermann negative. Has marked hypotonia of all the muscles of the body. At the sacrolumbar joint there is an angular kyphotic protrusion present with a secondary lordosis to the left (Fig. 14). No signs of inflammation. At one time a swelling occurred over the Charcot's kyphos. The swelling was increasing in size but patient had no pain. It only gave him some discomfort when lying down. The fluid was aspirated and found to be degenerated leucocytes and plenty of débris but no bacteria.

[1] This patient was seen by Charcot personally in 1900 (?) and was probably included in his reports.

Fig. 15. Case 10. Ununited fracture of the neck of the femur. Some new bone is thrown out.

Many cases of spontaneous fracture occur in tabetics due to the spongy condition of the bones and this is frequently the first symptom observed. This may be the first impetus to call the attention of the physician to examine the patient carefully, and one finds that patient has Argyll-Robertson's pupils, loss of knee jerks, etc. H. L. Taylor in a recent paper reports nine cases of spontaneous fractures coming under his observation. Crush fractures of the tibial tuberosities are especially liable to be followed by Charcot's joints.

CASE 10. D. W., male, married, age 53. Previous history: Has had tabes for the last fourteen years. Gives a distinct history of syphilis. While walking he slipped on the floor or, as he expressed it, "the knees gave way," and patient broke the neck and shaft of the left femur (Fig. 15). They never united although two years passed, and patient was confined to bed ever since.

I am greatly indebted to Dr. George R. Elliott, visiting orthopedist of the Montefiore Home and Hospital, for his kind assistance,

to Dr. S. Wachsmann, medical director of Montefiore Home for permission of reporting the cases, to Dr. C. Gottlieb and to Dr. S. Ehrenreich for taking the radiographs of the above reported cases.

BIBLIOGRAPHY

1. ABADIE. Nouvelle Iconogeraphie de la Salpetrière. 1900, xiii.
2. ALLBUTT. System of Medicine, 1910.
3. ALBEE, FRED H. Charcot's Arthropathy, 1912, J. M. Soc., N. J.
4. BLENCKE, H. Ztschr. f. orthop. Chir., 1903–1904, Par., xii, 632.
5. DANA, C. Nervous Diseases and Psychiatry, 1908.
6. ETIENNE, G., and PERRIM, M. Anti-syphilitic Treatment of Tabetic Arthropathy. Presse méd., Par., 1911, Oct.
7. ELY, LEONARD W. Joint Tuberculosis, 1911.
8. GOLDTHWAIT, PAINTER, and OSGOOD. Diseases of the Bones and Joints, 1910.
9. JONES, S. FOSDICK. Vertebral Osteo-arthropathy. Am. J. Orth. Surg., 1913, x, 363–381.
10. KRUEGER, MAX. Tabetic Arthropathia. Mitt. a. d. Grenzgeb. d. Med. u. Chir., xxiv, 119.
11. VON LEYEDEN. Tabes Dorsalis. Monograph, 1901.
12. OSLER. System of Medicine, 1909.
13. ROASENDA. Nouvelle Iconographie de la Salpetrière. 22, 1909, 509.
14. SPILLER, W. G. Arthropathy of the Vertebral Column in Tabes, Am. Med., 1902, iv, 701.
15. TYSON. Practice of Medicine, 1911.
16. TAYLOR, HENRY LING. Spontaneous Fracture as an Initial or Early Symptom of Tabes Dorsalis, Post-Graduate, 1912, xxvii, 970–982.
17. TOUSEY, SINCLAIR. Radiographic Findings of Syphilitic Bones. Med. Electricity, 1910.
18. WHITMAN, ROYAL. Orthopedic Surgery, 1910.
19. ZOEPFEL. Tabetic Bone and Joint Disease. Berl. klin. Wchnschr., 1911, xlviii, 2032.

# THE INGUINAL ROUTE OPERATION FOR FEMORAL HERNIA; WITH A SUPPLEMENTARY NOTE ON COOPER'S LIGAMENT[1]

M. G. SEELIG, M. D., ST. LOUIS
Professor of Surgery, St. Louis University
AND
LISTER TUHOLSKE, M. D., ST. LOUIS
Instructor in Anatomy in St. Louis University

THREE recent contributions to the literature of femoral hernia by Moschcowitz (1), Lance (2), and Didier (3) render it unnecessary to review the subject from a bibliographic point of view. There are certain fairly well-rooted misconceptions regarding femoral hernia, however, that call for correction. Among these false notions, the three most important are, that the repair of a femoral hernia is an essentially simple operation, that recurrence is a great rarity, and that, as contrasted with the typical inguinal hernia operation, the technique for femoral hernia does not require an anatomical exposure of the operative field. The fallacy regarding the simplicity of repairing a femoral hernia is easily demonstrated by witnessing a hospital house surgeon, thoroughly competent to do routine operative work, attacking his early series of femoral herniæ; if this does not furnish conclusive evidence, one has only to tackle a femoral hernia of the variety with a small empty sac, surrounded by a large clump of preperitoneal fat, in an obese subject, or better still, a strangulated femoral hernia requiring intestinal resection, and presenting the difficulty of pulling down sufficient healthy bowel to perform an anastomosis.

The statement that femoral hernia does not tend to recur, if only the sac is ligated and no attempt is made to close the femoral ring, is not true. In the case of inguinal hernia, three factors are supposed to safeguard against recurrence: (1) High ligation of the sac; (2) snug closure of the internal ring, with secure buttressing of the abdominal wall; and (3) aseptic wound healing. It is difficult to see why these same factors should not govern in the case of femoral hernia. As a matter of record, recurrences occur with astonishing frequency after femoral hernia operation. Bresset (quoted by Lance) studied 395 femoral herniæ, and of this number 232 which were operated upon without closure of the femoral ring showed a 29 per cent recurrence, and 163 which were operated upon with the

[1] From the Anatomical Department of St. Louis University.

closure of the ring showed an 8.6 per cent recurrence. Moschcowitz (loc. cit.) reports an interesting case in which he had operated for femoral hernia and had secured a seemingly ideal result. About a year and a half later he was obliged to perform a laparotomy on the same patient. Examination from within the abdomen revealed a recurrence, the sac being two inches deep. Pott (4) analyzed 422 cases of femoral hernia and found that there was 36.7 per cent of recurrences in those cases in which the femoral ring was not sutured, and 28.4 per cent of recurrences in those cases in which the ring was sutured. (The methods used for closing the ring were such that secure closure was impossible.)

The third fallacy, namely, that an anatomic exposure of the field is not essential in the performance of an operation for the cure of femoral hernia, serves as the chief point of attack of our contribution to the subject. We wish to show that such exposure is not only essential, but also that by considering and making it essential we, at the same time, render femoral herniotomy a much simpler operation and one much less likely to be followed by recurrence. Possibly the reason why anatomic exposure has not been considered necessary is that the vast majority of femoral herniæ are repaired by the crural route; and when a femoral hernia is attacked through a thigh incision, it is physically impossible to secure an anatomic exposure. This statement is beyond all doubt or question and may be proved easily by anyone who will take the time to dissect the region of the femoral ring and canal.

It is an unfortunate fact that practically all the illustrations of the anatomy of the femoral ring, in practically all the standard text and handbooks of anatomy and surgery, are so made that the average individual cannot orient himself properly in regard to the structures pictured. It is equally unfortunate that probably the most important structure utilized in the closure of the femoral ring, namely, Cooper's ligament, is not only not pictured in any of the anatomies, but also is not adequately described in most of them. For these reasons we have dissected a female pelvis and have had it drawn accurately to scale to show the exact anatomic relationships at the femoral ring.

Figure 1 is a representation of a female pelvis tilted slightly downwards and viewed from the front, and slightly from the right side (left side of the observer). The abdominal muscles have been cut away, the external oblique aponeurosis has been trimmed off, just above its reflection, and the transversalis fascia has been cut away just above the point where it begins to line the pelvis. This illustration shows the femoral ring, occupied by a loop of ileum and bounded by the following structures: Externally, by the external iliac vein, anteriorly by the Poupart's ligament, internally by Gimbernat's ligament (which is covered by a reflection of the transversalis fascia and which, therefore, is not lettered in the illustrations) and posteriorly by Cooper's ligament, investing the iliopectineal line of the os pubis. (The deep epigastric artery, which shows in our other illustrations, is concealed by the loop of ileum.)

A properly performed operation for the cure of femoral hernia by the inguinal route renders it possible to outline the structures in and about the femoral ring as clearly as they are pictured in our illustration, difficulty being encountered only in very obese subjects. The incision is the usual one for the repair of inguinal hernia, modified only in so far as its lower end approaches the pubic region more closely than does the ordinary inguinal hernia incision. The incision should be from three to four inches in length and, if necessary, may be continued downward onto the thigh, as is described later under "step 4."

The second step in the operation consists in dividing the aponeurosis of the external oblique in the direction of its fibers.

The third step is illustrated by Fig. 2. By raising up the upper flap of the external oblique aponeurosis, the conjoined internal oblique and transversalis are brought into view, a retractor is slipped under these muscles and used to retract them upward. Another retractor is slipped under the lower flap of the external oblique aponeurosis, which is retracted downward, bringing Poupart's ligament into full view. A bridle of tape or gauze is now passed under the round ligament

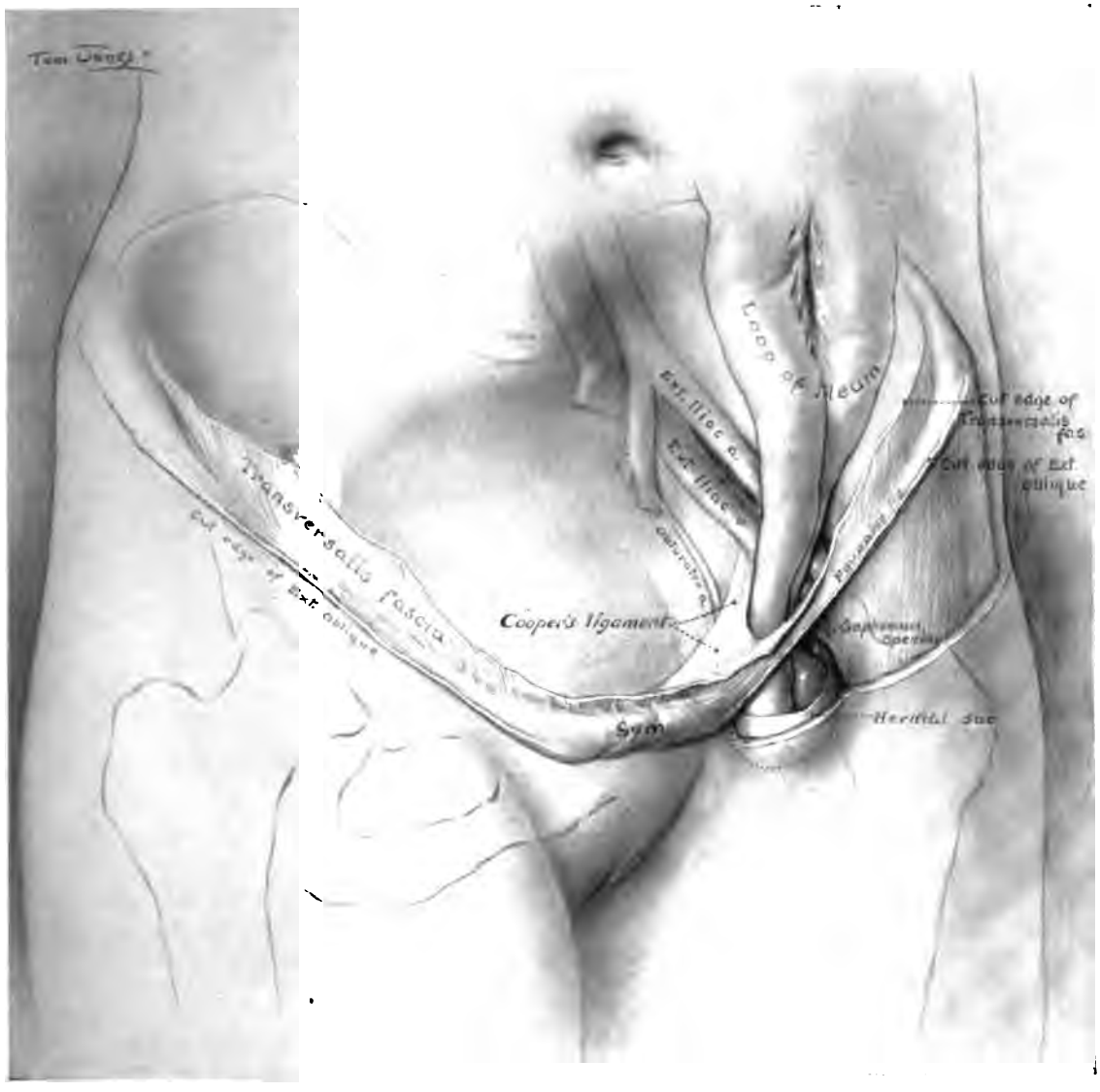



Fig. 1. Dissection of female pelvis to show the structures forming the femoral ring. The pelvis is tilted slightly forward and is viewed slightly from the right side.

or spermatic cord, and used to retract either of these structures upward. Good retraction gives a very free exposure of the field of operation, at this stage, and presents to view the transversalis fascia — a thin layer of fascia lying immediately anterior to the peritoneum. This transversalis fascia is nicked, divided bluntly along the line of the original incision, and then picked up in the retractors exactly as were the other structures of the upper and lower flaps of the incision. Good retraction brings the peritoneum into view and exposes the neck of the sac. In Fig. 2 the upper flap of the transversalis fascia is shown in the retractor and the lower flap is pictured free in order to illustrate its relationship to the underlying peritoneum. The deep epigastric artery is usually encountered during this stage and may be retracted or, if it runs an anomalous course, divided between ligatures.

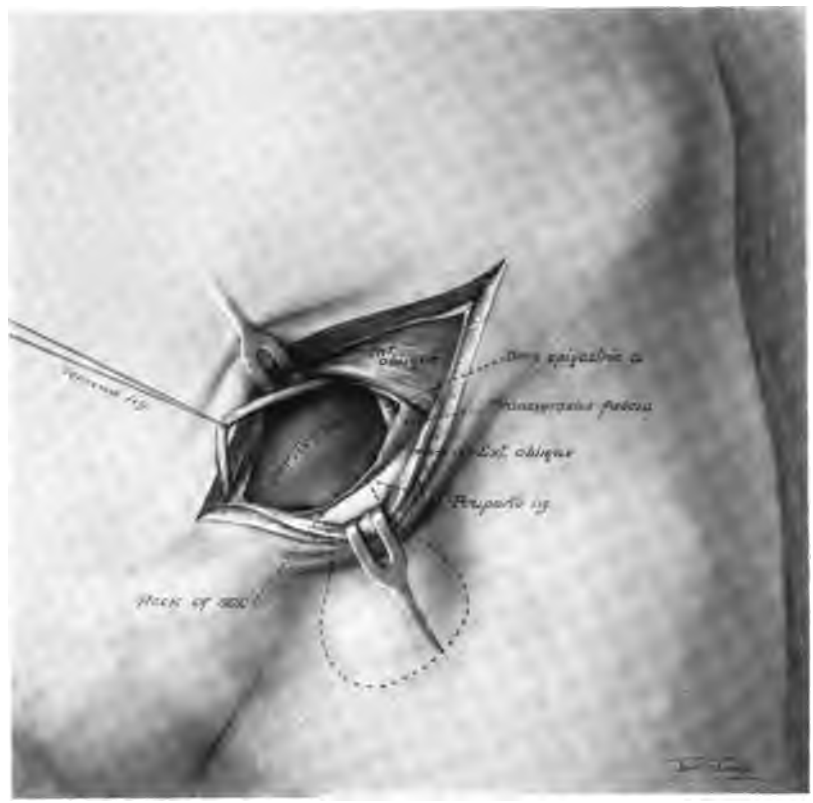


Fig. 2. Skin, subcutaneous tissue, external oblique and transversalis fascia have been incised and the upper and lower flaps retracted upward and downward respectively.

The fourth step consists in opening the peritoneum just as it converges to form the neck of the sac. Through this opening the hernial contents are pulled out of the sac, replaced in the peritoneal cavity and held there by a gauze pack, if necessary. If the intestine or omentum is strangulated, it may be liberated with ease by cutting Gimbernat's ligament, which forms the sharp inner margin of the constricting ring. Gimbernat's ligament is in full view, thus rendering it impossible to encounter uncontrollable hæmorrhage from an anomalous obturator artery. When one operates from the thigh and is obliged to cut Gimbernat's ligament blindly with a blunt pointed bistoury, one can never be sure that he will not encounter the so-called *corona mortis* (crown of death) formed by the anomalous obturator. If the hernial contents are adherent to the sac, one of two things happens: (1) Either the sac is *not* adherent to the tissues of the thigh (and it is almost the invariable rule that it is *not* adherent), in which case traction on the hernial contents pulls the entire sac out of its bed, converting the femoral into an inguinal hernia and thus enabling the operator to deal conveniently with the adhesions between sac and sac contents, or (2) the sac is adherent to its bed, in which case the inguinal incision is extended downward on the thigh, over the hernial protrusion, thus enabling the operator to dissect the sac free from its adhesions to fascia and cellular tissue.

Let us assume that we are dealing with a typical case. The fourth step has been completed, the hernial contents have been extracted from the sac and reduced into the abdominal cavity and we are ready for the

Fifth step, which consists in introducing a

Fig. 3. The sac has been delivered, ligated high and amputated. The three chromic gut sutures for closing the femoral ring are in place, ready to tie.

dressing forceps into the sac, down to its lowest point, then closing the forceps and withdrawing it. This procedure everts the sac and converts the femoral into an inguinal hernia. The sac is now tied off by transfixion ligature or by suture and, as may be seen in Fig. 3, it is tied off with ease sufficiently high to guarantee absolutely against leaving a dimple, protrusion or any other variety of potential hernia behind. If the sac does not evert easily, we know that it is adherent to the bed in which it lies, and we must proceed to dissect it out by retracting the lower skin flap or by enlarging the incision as described above under the head of "fourth step."

The sixth step consists in closure of the femoral ring. The ring is exposed to full view by retracting the lower flap of the external oblique downward and outward and by retracting the skin, the upper flap of external oblique, the tendon of internal oblique and transversalis muscles and the transversalis fascia upward and inward (Fig. 3). The ring is bounded by the external iliac vein externally, by Poupart's ligament anteriorly, by Gimbernat's ligament (covered by a reflection from the transversalis fascia) internally, and by Cooper's ligament posteriorly. A detailed description of Cooper's ligament is furnished in the supplementary note at the end of our paper. It is sufficient to point out here, that when the parts are retracted, as we have described, one can palpate the horizontal ramus of the pubis and can see it covered by a dense, tough, white, glistening fascial membrane. This membrane is Cooper's ligament. With a small, full curved needle one takes a deep bite through Cooper's ligament (deep enough to go down to the periosteum of the pubic bone) just internal to the

iliac vein, and then another bite through the lower flap of the transversalis fascia and the edge of the Poupart's ligament. Another suture is similarly placed internal to the first one, and a third one still further internally, if necessary (Fig. 3). The most internal suture always picks up Gimbernat's ligament. When these sutures (we use chromic gut) are tied, they approximate Poupart's to Cooper's ligament and effectually close the hernial orifice. In placing the first suture the external iliac vein is protected against possible puncture with a small curved retractor.

The seventh and last step resembles the ordinary closure of an inguinal hernia. Chromic gut sutures approximate the internal oblique and transversalis muscles (including the upper flap of the divided transversalis fascia) to Poupart's ligament. We usually do not transplant the cord or round ligament. Finally the external oblique is sutured and then the skin incision is closed.

The operation as we have described it and as we execute it is practically indentical with the description furnished by Moschcowitz (loc. cit.). As the result of our experience we feel that Moschcowitz's enthusiastic recommendation of the operation is more than warranted[1] and that as regards rationality, simplicity and safety, this operation stands in the same relationship to femoral hernia that the Bassini operation does to inguinal hernia. In strangulated femoral hernia, requiring intestinal resection, the inguinal approach renders resection and anastomosis a comparatively easy procedure. There is never any need to consider, even for a moment, the supplementary abdominal incision, which is recommended by so many authors as a routine step in femoral hernia when resection is indicated.

### SUPPLEMENTARY NOTE ON COOPER'S LIGAMENT

The inguinal attack on the femoral hernia has not come into more general use, largely because the various authors who have recommended the method have invariably emphasized the importance of Cooper's ligament, without devoting even so much as a line to its description. In closing the femoral ring, one is confronted with the necessity of suturing Poupart's ligament to Cooper's ligament and one is very apt not to know what Cooper's ligament is. If one attempts to inform himself, in the usual way, he finds that in Quain's Anatomy (first edition) the subject is not mentioned, in Cunningham's Anatomy (third edition) likewise no mention is made of the structure, in Morris' Anatomy (edition of 1907) the ligament is not described, and in Gray's Anatomy (edition of 1905) it is described most briefly in one place as "a strong ligamentous band," etc. (page 437), and in another place as "a small reflection from the tendon of the transversalis" (page 448). The average surgeon, in his own library, is not equipped to furnish himself with adequate information concerning Cooper's ligament. Indeed, one of the results of our investigation has been the discovery that even the anatomists are not in agreement.

In 1804 Astley Cooper published, at London, his classical work on "Anatomy and Surgical Treatment of Abdominal Hernia." In 1827 a second edition was edited by C. Aston Key. Copies of either of these editions are difficult to procure. Fortunately, however, in 1844, an American edition was put out by Lea and Blanchard at Philadelphia. This American edition is a verbatim copy of the second London edition as regards text. In this work on hernia, Astley Cooper for the first time described the ligament which now goes by his name.

A surprising and almost ludicrous phase of the subject is that one really cannot find Cooper's ligament in Cooper's own book, unless one has discovered in advance what the ligament is. By consulting the larger French and German handbooks or systems of anatomy, one finds that the ligamentum cooperi is, in reality, the ligamentum pubicum, and then if one goes through Cooper's work again he finds that on page 31 (American edition, loc. cit.) Cooper describes the os pubis as being "covered by a ligamentous expansion, which forms a remarkably strong production above the linea iliopectinea, extending from the tuberosity of the pubis outward, and pro-

[1] Moschcowitz very modestly lays no emphasis on a claim to having devised the operation, but his clear description should do much toward popularizing the inguinal attack on femoral hernia.

jecting from the bone over that line." Later he refers to this ligament as "the ligament of the pubes," thus establishing the identity of this structure with the "ligamentum pubicum." Of course, Cooper never utilized this ligament for closing a hernial ring, for in the days of Cooper, hernial rings were not closed.[1]

Cooper's own description, as we see, is not adequate, and it is necessary, therefore, to supplement it with the more detailed investigations of modern anatomists. The three best descriptions that I have been able to find are those by Poirier and Charpy, Testut, and by Eisler (in Bardeleben's Handbuch).

Testut (5) says: "The superior border of the pectineal crest is covered by a sort of fibrous cord, very thick, very dense, very resistant, intimately adherent to the bone, and extending from the spine of the pubis to the iliopectineal eminence. This is the pubic ligament of Cooper, or more simply termed, Cooper's ligament. The morphological significance of this fibrous structure, lying on the sharp, bony angle of the pectineal crest, does not appear to be clearly understood. Various authors describe the ligament of Cooper as a fusion, at the same point, of various fascial layers: pectineal aponeurosis, Gimbernat's ligament, Colles' ligament and the fascia transversalis, all of which find insertion into the pectineal crest. But the ligament of Cooper does not consist of these fasciæ alone, for it is made up also of other structures, of which the principal ones come from the lateral margin of the adminiculum of the linea alba."

Poirier and Charpy (6) furnish the following description of the ligament: "The iliopectineal line of the pubis marks the point of fusion of various fascial layers: the pectineal fascia, Gimbernat's ligament, behind this the posterior pillar of the external ring, and finally the transversalis fascia, re-enforced by the ligaments of Henle and Hesselbach. Thus the angular bony edge overladen by all these insertions is transformed into a rounded cord, which is given the name of the pubic ligament of Cooper — Cooper's ligament."

Finally Eisler, in Bardeleben's (7) extensive Handbook of Anatomy, describes Cooper's ligament as follows: "The fascia of the pectineus muscle (which covers the muscle as a thin fascial aponeurosis) changes at this point (i.e., the crest of the pubic ramus) into a strong, flat, tendinous cord, which runs parallel to the horizontal ramus of the pubic bone, finally reaches the ramus and projects over it. This cord, the so-called ligamentum pubicum (Cooperi) passes laterally and dorsally over the iliopectineal eminence and ends on the ilium. Mesially it extends over the mesial end of the horizontal ramus of the pubis, onto the superior surface of the body of the pubis. All of the structures previously mentioned furnish fibers to the ligamentum pubicum — (these structures are: tractus iliopubicus, falxinguinalis, ligamentum Collesi, ligamentum interfoveolare, interfoveolaris muscle, and the common aponeurosis of the obliquus internus and transversus) and in addition to these, there are fascicles from the adminiculum lineæ albæ, sometimes fibers from the tendon of the psoas minor and regularly, on the deep surface, fibers from the origin of the pectineus. As a matter of fact, we may assume, with safety, that Cooper's ligament is developed essentially from the pectineal fascia as a result of the varying pull of the different fibrous strands that radiate into it. Moreover, Cooper's ligament forms only that part of the pectineal fascia which is especially taxed by the above-mentioned pull."

It is evident from the above three translations that even the authorities on anatomy are not in complete agreement. The descriptions enable us, however, to orient ourselves very clearly regarding the gross anatomic relationships of Cooper's ligament. The important feature from the surgical point of view is merely this: When the ramus of the pubis is exposed by an inguinal incision, it is seen to be covered by a thick fascial bundle. This fascial bundle is Cooper's ligament.

[1] Cooper states quite naïvely that some surgical writers have actually proposed tying off the hernial sac, but that such an operation is not only useless, but also dangerous, due to the inflammatory peritonitis set up by the ligature. He quotes instances of death from suppurative peritonitis caused by ligating the neck of the sac.

BIBLIOGRAPHY

1. A. V. Moschcowitz. Femoral Hernia: A New Operation. N. Y. St. J. Med., 1907, Oct., 396.
2. M. Lance. Travaux Recents sur la Cure Radicale de la Hernie Crurale. Gaz. d. hôp., Par., 1912, No. 38, 1941.

3. ROBERT DIDIER. Cure Radicale de la Hernie Crurale. Paris Thesis, 1912.
4. OTTO POTT. Zur Prognose der Radical Operation der Hernien. Deutsche Ztschr. f. Chir., 1903, lxx, 556.
5. L. TESTUT. Traité d'Anatomie Humaine. (Sixth edition.) 1911, i, 862.
6. P. POIRIER and A. CHARPY. Traité d'Anatomie Humaine. Tome 2, p. 485, Paris, 1899.
7. K. VON BARDELEBEN. Handbuch der Anat. des Menschen. Muskeln des Stammes bearbeitet bei P. Eisler. Bd. 2, p. 641, Jena, 1912.

# CONGENITAL DISLOCATION OF THE HIP; A RATIONAL METHOD OF TREATMENT[1]

BY HARRY M. SHERMAN, M. D., SAN FRANCISCO

WHAT I wish to say about congenital dislocation of the hip will be said from a purely clinical viewpoint. Clinically, then, we have to deal with a condition complex. This complexity includes a more or less incompetent acetabulum, a more or less imperfectly formed femoral head, a more or less shortened or distorted femoral neck, and a more or less elongated and narrowed capsular ligament.

The acetabulum is commonly shallow and lacking in its upper rim, in that the iliac component does not supply a broad overhanging mass to support the body weight on the femoral head.

The femoral head may be stunted, and commonly its ossific nucleus is displaced to a position external to the normal, and development must then result in an atypical head.

The femoral neck is, in most instances, of practical if not normal length, but it is, again, in most instances badly misdirected by a twist in the shaft, so that in the ordinary position of the limb the head is projected forward.

The capsule always has its normal attachments to the acetabular rim proximately and to the base of the femoral neck distally, but between the acetabulum and the femoral head it is elongated and therefore commonly contracted, so that its lumen is less than the diameter of the femoral head while its walls are thickened because of its reaction to the unintended work of having to support and carry the body weight in walking.

Of these potential complexities, that of the acetabulum, whatever it may be, is irremediable. The early operations which deepened the socket by excavation not only took away articular cartilage, but encroached upon epiphyseal lines and therefore interfered with growth. This practice was a phase in the development of a technique and has quite rightly been abandoned. We must take the acetabulum very much as we find it, but we may expect in some cases, after a successful reposition, a not inconsiderable amount of development along relatively normal lines from proper use of a hitherto unused part. Complete acetabular incompetence may be a cause of failure of reposition or of reluxation.

The femoral head belongs in the same class; no successful attempt has ever been made to remodel this part. In some instances a manifestly incompetent head has been ablated, but this has only robbed the patient of such poor support as the deformed head might have given, without offering the possibility of a substitute.

The femoral neck, commonly adequately long, is so frequently misplaced, by being directed forward, that it fails to correlate with the acetabulum. This distortion can be appreciated in the radiograms; for, if it be present, a radiogram taken of the hip with the toes of that foot pointing forward will show the neck and head obscured by the trochanter, or foreshortened. If now another radiogram be taken with the toes pointing inward (inward rotation of the limb through 90°), the neck and head will be seen in profile, and their practicability can be easily estimated (Figs. 1 and 2). The twist of the femoral shaft is the commonest cause

[1] Read before the American Surgical Association, Washington, D. C., May, 1913.

Fig. 1. Radiogram of a congenital dislocation of the hip, taken with the foot in the usual anteroposterior plane. The femoral neck appears foreshortened—apparently an incompetent part—not capable of proper articulation with the pelvis.

Fig. 2. Radiogram of same hip as in Fig. 1. Taken at the same time, but with the limb rotated in so that the foot is in a transverse plane and the toes point to the leg of the opposite side. The femoral head and neck come out in profile and the part is seen to be competent and capable of proper articulation with a competent acetabulum.

of reluxation, and of the inability to hold the femoral head in any better position than the so-called anterior transposition. In general, when the dislocated femoral head is found above the acetabulum, under the internal thigh rotator muscles, the femoral shaft will have the anterior twist; while if the head is found back on the dorsum of the ilium and shows there prominently when the child stands, the twist will not be present; but this is not an absolute rule.

The capsule and its elongated and narrow shape is the real obstacle to easy reposition. If its lumen is smaller than the femoral head it is impossible to thrust the head through it, for it is a very firm structure and not distensible. I base this statement on the fact that I have often thrust my finger down to its narrowest part, just at its attachment to the upper rim of the acetabulum, and I have sometimes—long ago—tried to dilate it with a powerful uterine dilator. It was always—except in one or two instances in which it was large—impassable to the finger, and the uterine dilator bent under the force applied but did not stretch the capsule. If this narrowest part be widened by an incision, the putting of the head into the acetabulum is an easy act, and commonly requires no force in children of the age best suited to the operation.

The operative technique proposed and practiced is as follows: In younger children, up to the age of five or seven, no preliminary treatment is needed. An incision is made from the anterior superior iliac spine downward, just external to the long head of the rectus femoris, between that and the tensor vagina femoris. This is the dividing line

between anterior crural and gluteal nerves, and none are cut, nor aught else but connective tissue, unless it be a small artery. The capsule over the displaced head is found lying just beneath the muscles mentioned. It is incised freely in the line with the incision already made. The hip is now flexed, which relaxes the capsule, and the gloved finger is inserted and passed into the capsule toward the acetabulum to the narrow part. A long-bladed straight probe-pointed bistoury is guided by the finger through the narrow place into the acetabulum. By pushing on the back of the blade with the finger inside the capsule, and making a to-and-fro motion with the holding hand on the outside, the capsule is cut downward through its lower part, so that the finger can slip along the knife into the acetabulum. This downward direction must be taken to avoid the femoral artery and vein. An ample opening of the acetabulum must be assured. Then, with the hip still flexed, guide and lift the femoral head over the rim into the cavity. At once extend the thigh, abduct it 70 to 75 degrees and rotate it inward 90 degrees—then flex the knee. This makes the long head of the rectus tight, and it lies just over the femoral neck in its new position and prevents anterior reluxation, and at the same time gives the plaster of Paris splint a much more efficient control of the femur, but it does put the limb in an awkward position. I formerly used to suture the capsule. Now I do not; the capsule at the outer side of the incision is carried downward and inward by the neck as it moves with the head into the acetabulum, and passes beneath the inner part of the same. The patent incision is an excellent drainage for the joint cavity, and when healing has occurred the reduplicated capsule is strengthened by the act. The opening in the fascia lata I suture with catgut and the skin with horsehair. The limb remains in the original plaster of Paris splint, which is a double spica, four or six weeks. Radiograms check up the accuracy of the reposition.

At the end of the four or six weeks the plaster is removed. Now, if there is a twisting of the femoral shaft, turning the head forward, I drive, while the limb is still held in inrotation, a long nail into the femur between the trochanters. Then I do a subcutaneous osteotomy just below the nail. Next, holding the upper fragment in the proper position by means of the protruding end of the nail, so that the head is in the acetabulum and the trochanter is in the normal transverse plane, I rotate the lower fragment out, so that the toes point a little (15 to 20 degrees) outward. Then another double spica of plaster of Paris is put on, and in this the end of the nail is buried so that the inward rotation of the upper fragment is maintained (Fig. 3). The reposition and osteotomy and the position of the fragments are again checked up by a radiogram. The nail remains *in situ* four to six weeks. The spica is undisturbed until the femur has healed and is firm. Splints, spicas of plaster of Paris, are put on at intervals for eight to twelve months, each succeeding one being a little shorter, and

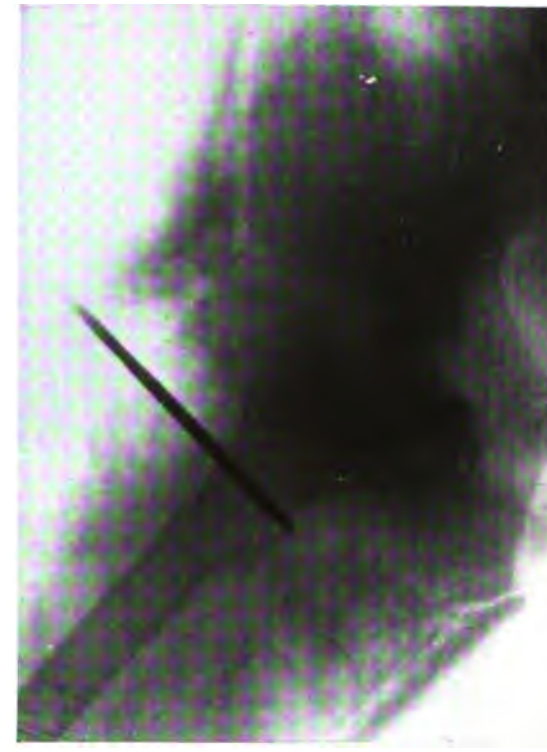


Fig. 3. Radiogram of a replaced hip, the head in the acetabulum, the nail holding the head and neck in a transverse plane, the line of the osteotomy of the shaft and the whole held by the plaster of Paris spica.

with each the limb being put in less abduction. Walking begins in the splint about two and a half to three months after the osteotomy.

With this plan I *know* I have put the femoral head *into* the socket of the acetabulum and not on it with the capsule interposed. A proper intimate contact of femoral and acetabular cartilages is secured. This for the first stage, which overcomes the obstacles of the capsule. The second stage puts the femoral head and neck into a proper relation both with the femoral shaft and the acetabulum, so that when the foot is in the correct anteroposterior plane the vertical plane of the neck and head is directed inward and a little forward, and the head enters the acetabulum properly so that the posterior side of the neck is not in contact with the posterior lip of the acetabulum. This lessens the likelihood of reluxation, and if the patient has but a practical head and neck and a competent acetabulum, reposition will be stable and function will be satisfactory.

The evolution of the plan is simple. The stiff hips following the earlier operations in which the acetabulum was deepened led me to try the manipulative method. The instability of reduction in one instance made me, immediately after the manipulative reduction, incise to find out what was the difficulty. I found bunched up capsule between the head and acetabulum. When this was cleared away and the head really entered the socket, reposition became stable. Next, I noticed—in cases thus treated—reluxations after a few months or years, and referring this to the known distortion of the shaft, I adopted the practice of the osteotomy.

There is another danger which has been avoided by this particular technique, though its imminence was not appreciated until very recently.

I had noticed an interference with growth, following the deepening of the acetabulum, in the case of a young woman upon whom I had done the original Lorenz operation when she was a little child. This operation, as you remember, deepened the shallow acetabulum. The reposition done on the child was stable, but she had a progressively increasing shortening of the limb during her years of growth. A radiogram, taken when growth had been obtained, shows the acetabulum at too high a level on the side of the pelvis, just as the acetabulum comes to be too highly located in the cases of hip-joint tuberculosis with involvement of the acetabulum and destruction of the epiphyseal line of the iliac component. Evidently the excavation and deepening of the acetabulum in the old type of operation interfered with epiphyseal lines and checked the normal downward growth of the iliac component of the socket.

With this technique of reduction through an incision, which really reduces, and osteotomy when it is necessary to fit the component parts of the joint to each other, I feel I can give my patients a full 100 per cent of their chances for a practical joint. I cannot recreate bony deficiencies, nor perfectly fit together wholly mismatched parts, but with a practical acetabulum and a practical head and neck I think the method should give a practically normal joint. A joint is a mechanical contrivance, and the test of its mechanical competence is its functional competence. A joint which has a functional competence equal to that of a normal joint is itself a normal joint. In many instances the radiogram may show variations in shape, size, and other details from the generally accepted form, but if the function is equal to that of a normal joint I claim that it is a normal joint.

As regards statistics: There have been twenty-nine hips reduced by incision with no osteotomy following. Of these, eight have gone into the position called anterior transposition. Three have stable reposition, but have developed coxa vara. One has, with no demonstrable infection, become completely ankylosed. In one, an infection of the incision caused death. Four we do not know about. Twelve have functionally normal joints.

This is 41.3 per cent of success.

There have been twenty-seven hips reduced by incision with an osteotomy following to correct a twisted femoral shaft. Of these, two have gone into anterior transposition because of incompetent acetabula. In two, the nail failed to hold the upper

fragment after the osteotomy, and the parts returned to their original relations. These cases were then as if no osteotomy had been done. In one instance, I must have encountered some osseous dystrophy, for the femur crumpled up in a simple and forceless manipulation, and though the reposition is stable, the alignment of the shaft is erratic, and will need correction later. Three are still under treatment. Nineteen have functionally normal joints.

This is 70.3 per cent of success.

---

# TUMORS OF LARGE NERVES ASSOCIATED WITH FIBROMA MOLLUSCUM, WITH EXHIBITION OF LARGEST SPECIMEN ON RECORD[1]

By NORMAN KERR, M. D., C. M., Chicago
Assistant Professor of Surgery, Chicago Policlinic

THE writer's interest in this subject is largely due to the enthusiasm of Dr. Carl H. von Klein, who was kind enough to furnish him with a complete bibliography of the subject, and this fact seems sufficient reason to make this paper of sufficient value to present to this society.

There is so much literature on the subject that only a few salient points will be dwelt upon in this paper, and anyone who may be interested further can refer to the bibliography.

The first well-described morbid condition of neuroma was written by Paul Aronson in his work entitled "Pathologie des tumeurs," in 1788, where he relates his observations and describes tumors composed of nerve fibers. F. X. Alexander, in a dissertation in 1800, speaks of such tumors developing either in the neuriline or in the nerve. These tumors were known under the name of nodular nerve tumors, tubercular nerve tumors, scirrhous nerve tumors, ganglion tumors, elephantiasis, and so forth.

Odier of Geneva, in his work entitled "Manual de Médécin Pratique, 1803," first introduced the term "neuroma," and describes a case of a species of aneurism of the radial nerve, and says all the nerve fibers spread fan-like from one another, or, like the ribs of a melon, their center is filled with a whitish matter and in some places yellowish; it is spread out in intervals of an infinite number of transparent vessels interlaced with one another. This description, says the great pathologist Virchow, evidently refers to a case of myxoma; he further says that every tumor has an organic, a morbid, or a normal structure; this defect can exist in the neurilemma, in the marrow of the nerve, in the arteries, in the veins or lymphatics of the sheath, or finally in the nerve substance itself. This essential point has induced Odier to term it neuroma. He also used the term neuroma for morbid tumors, circumscribed and deep, which are caused by accidental swelling of a nerve and at the extreme stage of which the tumor causes very severe pains.

In Hyde's eighth edition "Diseases of the Skin," which I understand was written by the late Dr. H. G. Anthony, fibroma molluscum is stated to be a developmental defect manifesting itself by the presence of tumors of the skin and other organs of the body, pigmentations of the skin and mucous membrane of the mouth and by defect in the mental development; one or both of the last two named symptoms may be absent.

*Symptoms.* The tumors are usually numerous and scattered irregularly over the entire body. They are from pea to egg sized and vary greatly, according to their age and dimensions. In early development they present dome-shaped pea to bean sized elevations which are softish, semisolid, or pasty with a normal epidermal covering. Later they are cone-shaped, semisolid formations, sometimes capped by an opaque summit

[1]Complete bibliography may be obtained by writing to the author.

which presents the appearance of a vesicle and which bleeds freely when pricked. Digital compression causes these tumors to disappear through a ring in the skin and when released, they spring back into their normal position. Old tumors are less gelatinous, are firmer, mammillated, often pedunculated. Small sized tumors may recede leaving an empty pouch of skin. When egg sized, the tumors are usually subcutaneous and are less lobulated than fatty tumors; when diffuse, especially in the face, they draw the skin into extensive folds—fibroma pendulum.

Occurring about the anus they present folds of tissue which resemble labia minora vulvæ and which annoy the patient in defecation. They are not painful when touched and they produce no subjective symptoms. In a given case tumors of all sizes and in all stages of development may be present. When very large, there may be a single tumor present which may be more or less pedunculated. The tumors may affect the mucous membrane of the mouth, large nerve trunks, suprarenal capsule, intestines and other internal organs. Patches of leucoderma, telangiectasia, patulous orifices of sebaceous glands, comedones and fatty tumors are not uncommon. Pigmentations are usually light to dark brown colored, freckles sprinkled over the entire cutaneous surface together with a few large patches of pigmentation; jet black points of pigmentation are sometimes observable in the larger areas. The freckles may be discernible in the negro.

Rolleston enumerates about ten conditions which seem to influence the congenital factor by increasing the lesions, viz., (1) trauma; (2) extreme cold; (3) chronic irritation of the skin; (4) physical influences; (5) overwork; (6) puberty; (7) pregnancy; (8) menopause; (9) infectious diseases. The large number of contributary influences given by this last named author seems to be an index of the lack of real knowledge of the etiology of this disease and the pathology as yet described is not very clear; however, Soldan gives the following conclusions:

First: The pigmented nævi are in the majority of cases the first symptoms of a fibromatous process in the connective tissues of the cutaneous nerves.

Second: The pigmentation is probably a result of the fibromatosis of the nerve connective tissue.

Third: The nævus cell nests and strands, as described amongst others by Unna, are neither epitheliomata nor lymphangiofibromata but neurofibromata.

Fourth: From the fibromatous process of the pigmented nævi develop dermoid tumors which are described as soft fibromata and elephantiasis mollis.

Fifth: The fibromatous process is not only confined upon the skin but may also appear on any place of the peripheral nerve system and may also lead to the formation of so-called pseudoneuromata and plexiform neuromata.

Sixth: The variety of forms of neurofibromatosis is caused by localization, anatomical conditions and energy of growth of the elements of the tumors.

We have to differentiate, therefore:

1. Neurofibromata of the larger nerve trunks, as far as they still show a distinct perineurium.

To these belong:

(*a*) Pseudoneuromata (fibroneuromata) characterized by the localized proliferation on single points of the nerve.

(*b*) Neuromata plexiforma. The proliferation attacks larger areas of the nerves equally.

2. Neurofibromata of the nerve end distributions after loss of the perineurium.

(*a*) Cell nests and strands of the nævi pigmentosi, verrucæ carneæ or mollis, fibromata mollusca, characterized by circumscribed proliferations in the skin.

(*b*) Elephantiasis congenita neuromatodes, pachydermatocele elephantiasis mollis, diffuse proliferation in the area of the distribution district of one or several larger nerve trunks of the skin.

Francini says: "In the nerve fibers and at any portion of their course the regression of the segmental elements of which they consist may take place for reasons hitherto unknown; by extensive proliferation they give rise to the formation of tumors, which in their construction reproduce distinctly the different stages through which the segmental cell passes to its complete differentiation."

As this is the case with other tissues, there also exists here a very distinctly perceptible parallelism between the various neoplastic forms and the structural changes, which may occur under other conditions of the increased activity in the nerve tissue. This conformity of facts can be easier studied between the true neoplasm and the amputation neuroma, which latter, though not of purely neoplastic nature, must from its histologic standpoint be counted among the myelinic neuromata because the picture that we obtain from them is in the most minute details equal to that which certain tumors that develop in the continuity of a nerve trunk may show.

The genuine tumors, supposing even the possibility that new formations of connectival origin may occur in the nerves, show the greatest variety of histologic symptoms, so that one is forced to presume the segmental nature of the same.

This perception is easier in tumors whose tissues correspond with earlier forms than those of the grown and normal nerve fibers.

A thorough examination may, however, in forms with absolutely embryonal characters and in those in which metamorphoses of various types develop, reveal the development of the new formation tissue from the nerve fibers which are in an extreme stage of cell regression.

The knowledge of the diffuse, congenital, and hereditary neuromata is more in conformity with the conception of the neuroplastic nature of these tumors than with the conception of a connectival origin, and on the other hand the localization of the changes upon few nerve bundles, whilst the others continue their way upon the periphery of the tumor, may make the study of this connection of the new formation with the connective tissue difficult.

The study of nerve tumors when performed systematically and leaning upon the knowledge which anatomy, embryology, and the experimental pathology of the peripheral nerve system have given to us, whilst it permits us to perceive all the deviations from the normal evolution which may occur in a nervous tissue, forms a tract which is worth while to be intimately followed and which may give us important results concerning the origin of the nerve fiber and its inner structure.

Von Recklinghausen, in 1882, gave such a good description of this disease that it bears his name.

From the local profession in Chicago we were given very interesting reports by Drs. R. B. Preble, L. Hekton and William Healy which show what a great variety of morbid conditions may accompany this disease.

There are four general divisions in the

symptomatology: tumors of the skin, tumors of the nerves, pigmentations of the skin and functional disturbances, which have been emphasized by Dr. Preble in his discussion of his remarkable case.

The writer's case is of interest because of the large size of the tumor which was removed from the left sciatic nerve January 29, 1912, at the Chicago Policlinic Hospital.

The following is the history:

E. Z., age 22, female, single, saleslady, previous health good. Family history negative so far as this disease is concerned. About seven years ago she was struck on the back of the lower third of left thigh by some one's knee while at a dance. No attention was paid to this until about a week later, when a swelling was noticed which grew slowly until at present it appears to be the size of a cocoanut, is of solid consistence, slightly movable in all directions when the posterior muscles of the thigh are relaxed, but fixed when they are held tense. There is no particular enlargement of the superficial veins and no disturbance of nerve function, except during the last four days, during which she has experienced a moderate amount of pain in the growth. Upon cutting down upon the growth it was found to involve the sciatic nerve and measured six inches in length by three in diameter and weighed one pound and three ounces. Dr. John A. Graham of the Policlinic Laboratory reported the tumor to be a fibroma.

In reviewing the literature, the writer found that several authors dwelt on the fact that the new growth of nerves is apt to displace the nerve fibers outward so that they may surround the growth or the growth may be, as it were, forced through one side, but in this case it was noticed that several fusiform enlargements about three-fourths of an inch long and one-quarter of an inch in diameter appeared on nerve bundles extending downward into the middle of the nerve trunk so that it was impossible to remove the growth without destroying nearly if not all the nerve fibers of this very important nerve trunk. The time since the operation has been too short for evidences of regeneration to show themselves on account of the great length of nerve trunk which was removed.

The photographs herewith presented were very kindly taken by Dr. D. C. Hoyt, and Dr. James C. Gill was also kind enough to examine the case for me twice since the operation with reference to its neurological findings.

# CYSTS OF THE OMENTUM[1]

## With Report of a Case

By V. A. FUNK, A. B., M. D., Vincennes, Indiana

THE more frequently a pathological rarity is encountered, the more it is circulated through our current literature of to-day, and the more thoroughly it is discussed before our gatherings; which is the only way in which the whole profession can expect to familiarize ourselves with the condition, while the different phases of the subject are slowly thrashed out, until a more or less settled idea of the same becomes general. Such has been the career of each pathological finding as it has presented itself before the scientific men of our profession, and while many obscure conditions have been brought out of the darkness, we know too well that too many are still far from being on a perfect understanding basis. In the latter class we must place the cysts of the omentum.

When we consider that only thirty-eight cases of cysts of this tissue have up to the present time been placed on record, we can easily understand how very rare the condition is, and we are not surprised when we search some of our journals from their first publication to the latest issue, without finding a single article upon the subject. Some of the cases reported are so indefinite that very few conclusions can be derived from them. The condition was first described in 1851, by Gairdeur.[2]

Cysts of the omentum are exceedingly interesting from two standpoints. First, we will consider the origin and pathology, which may be termed the scientific side. From the cases reported, they have been classified as follows: Embryonal, which is advanced mostly from the fact that these cysts usually occur in childhood, fifty per cent occurring before the age of ten and sixty-five per cent occurring before twenty-one. Hearns[3] reports a case of a boy, eight years old, who had a fluctuating tumor at birth which decreased in size for a while, but again enlarged and was aspirated at the age of four years. Upon refilling, an omental cyst was removed four years later. Nearly all observers believe some of the cysts to be embryonal in origin, claiming we can have embryonal rests here as well as in any other part of the body. The echinococcic origin has never been proven in the pathological laboratory. Lymphatic originating from either the vessels or nodes has held much favor. Rokitansky ventured to make the assertion that all omental cysts were of this origin, terming them as either dilated lymphatic vessels or dilated lymph nodes. Hæmorrhagic origin for four of the above cases contained coagulated blood, and eighteen contained a dark fluid, which from all appearances was partially blood at some time. Dowd[4] reports a case of a man aged twenty-six with an omental cyst, with a pedicle made up of twisted omentum, the origin of which he thought was as follows: Hæmorrhage from some cause into the omentum forming a hæmatoma. Absorption of the hæmoglobin and degeneration of the blood cells followed by torsion with œdema and transudation of the watery elements of the serum into the cyst's cavity. Fort's[5] case of a boy two and one-half years old contained dark bloody fluid. The case which I will report later, I am inclined to believe had its origin from an embryonal rest, because it had a definite capsule and the fluid was negative and as perfectly clear as spring water.

The pathology varies greatly in the different reports. The contents have been lymph, chyle, serum with and without the presence of blood cells, dark fluid containing coagulated blood, and clear watery fluid. Very few have contained a definite capsule, most of them separating the folds of the omentum with no further encapsulation whatever. They have also been reported as being outside the

[2] Tr. Path. Soc., Lond., 1851.

[3] Quoted by Van Hook and Kanavel in Keen's Surgery.

[4] Ann. Surg., Phila., 1911.

[5] Ann. Surg., Phila., 1903.

[1] Read at the Second District Medical Association of Indiana, Washington, D.C., September 4, 1913.

omentum and attached by thin adhesive bands, which fact led Phillips[1] to suggest that these might have had their origin from the ovary, and by twisting of the pedicle were detached and continued their existence by receiving nourishment from the omentum. When the cyst has a definite wall it is held to the omentum, which usually forms a second or outer wall by light adhesions, and is nourished by vessels running directly from the omentum. When the cyst becomes extremely large, adhesions will be formed between the omentum and parietal peritoneum due to the pressure. Two dermoid cysts have been reported by Waldy[2] and Wells.[3]

The most interesting part of the subject is from the practical standpoint, which includes both the diagnosis and treatment. The fact that only two cases out of the above number were diagnosed before operation emphasizes the weakness of our diagnostic ability in these conditions. Pean[4] holds three points as of paramount importance in the diagnosis of omentum cysts: superficial location; abnormal passive mobility with the downward movement limited; and absence of functional disturbance. These points would aid us only before the growth had reached any great size, for when the abdomen has become completely filled with the tumor and is adherent to the abdominal wall, as in the case I am reporting, the location is not diagnostic; there is no mobility whatever, and we usually have dyspnœa, palpitation, indigestion, and constipation due to the pressure.

When the cyst is not large, the location at the umbilical region and above the intestines, with free motion in each lateral direction and upward, but only to a limited degree downward; not disturbed by the respirations; not causing the patient any disturbance whatever; the general health being perfect and the tumor slowly getting larger, would be very suggestive of an omental cyst, and I think a diagnosis should be made from the above picture if seen at the proper time.

Several observers have reported pain, which radiated toward the liver. Vomiting and diarrhœa alternating with constipation, and cachexia have been noted in extreme cases. Palpation reveals a movable fluctuating growth, which is pathognomonic of cystic growth of the abdomen, the only exception being a lipoma which sometimes fluctuates. Pancreatic tumors, while having their location in the umbilical region, usually occur later in life and give constant pain and if malignant produce fatty stools and icterus. Mesenteric cysts usually have a coil of intestines between the tumor and the abdominal wall with a lessened area of mobility. This condition has been conflicted with ascites, lipoma, aortic aneurism, cysts of the liver, pancreas, urachus and tubercular peritonitis.

The treatment may be summed up in a single word — removal. Tapping, which is always a very dangerous procedure when dealing with abdominal conditions, will only relieve, and the cyst is sure to refill. Hearns tapped his case but was compelled to operate later. Fort aspirated, not for a palliative remedy, but because he was afraid to release the great hydrostatic pressure from the splanchnic vessels suddenly, so he removed about five pints of the fluid and operated five days later. Matthews[5] cites a case of a boy, eight years of age, who was tapped four times with a refilling each time, and the condition of the patient becoming worse. The puncture through the cyst wall may remain patent and peritonitis follow from the leakage. If the cyst has a definite capsule, it can be freed from its adhesions, and removed *in toto*. Should there be no cyst wall except the omentum itself, that portion forming the cyst can be removed. If there is a pedicle formed either from an adhesion or a twisting of the omentum, this can be tied off and the tumor removed. With a recovery of 86 per cent of the cases reported, we need not fear the radical operation, as it is the only means of a cure. These cysts confront the surgeon when he least expects them, and a very great mistake indeed might be the outcome in the hands of an inexperienced operator.

CASE 1. The patient, a girl aged seventeen, entered the Good Samaritan Hospital, July 7, 1913. Her family history was negative. The past history was

[1] Kings' Hosp. Rep., Lond., 1896.
[2] Lancet, Lond., 1889.
[3] Brit. M. J., 1890.
[4] Quoted by Van Hook and Kanavel in Keen's Surgery.
[5] Brit. M. J., 1905.

good with the exception of pneumonia, which kept her in bed two weeks. This occurred three years ago, following which she first noticed a slight enlargement of the abdomen. The abdomen has slowly grown larger since that time. From the beginning of the growth, which they thought was never localized, but general, she had no symptoms whatever, until the summer of 1912, when she was confined to bed two weeks with severe pains in both inguinal regions, radiating to the back only. The pain was most severe on the right side. She had two or three chills followed by fever, none that she knew of at any other time during her trouble. After getting out of bed she could not straighten up for several days. Urination too frequent at this time, but normal since. A slight leucorrhœa was present while in bed, but stopped a few days afterwards. Bowels have been constipated since she first noticed the trouble, requiring purgatives constantly. The periods begun at the age of thirteen, and have always been regular and normal, except at this last attack, when she missed three or four months, following her confinement to bed. The patient the last three years had taken cold easily, with hoarseness, which held on unusually long, but she had no cough between them. The abdominal pains had totally disappeared the last six months. There had been very little increase in the abdomen the last eight months. On examination, the patient was very much emaciated. The abdomen was as large as a nine months' pregnancy. The whole abdomen was distended and a distinct fluctuation wave could be felt from any angle across the abdomen. The percussion note was dull with the exception of two small areas at either side of the lumbar spine. Changing her position did not alter the percussion note, due to the abdomen being so tightly filled with the tumor. Vaginal examination was negative. The temperature did not go above 99° F. The W. B. C. was 8,000, reds 4,000,000, hæmoglobin 80 per cent. The urine was normal. The only symptoms she complained of were shortness of breath and palpitation on exertion. A diagnosis of tubercular peritonitis was made with a probable origin at the appendix or Fallopian tube. On opening the abdomen the fluid was found to be encapsulated. I then thought it to be an ovarian cyst, as they are the more frequent, but on examination the tubes and ovaries were normal, and the tumor had no attachments in the pelvis whatever. I then decided to drain the cyst to make room in the abdomen for further examination. On cautiously going through the cyst wall, it was found to be made up of two distinct layers, the first a very vascular layer, which proved to be the omentum, and the second a fibrous layer, which was the capsule proper. After evacuating over three gallons of perfectly clear fluid, the cyst wall was easily removed from its omental bed, by dry dissection, there being only five or six nutrient vessels which required ligation. The tumor had no pedicle whatever, nor were there any strong adhesive bands connecting the cyst wall to the omentum. The omentum completely enveloped the cyst. The pathological report, which was made by Dr. Wm. Litterer of Nashville, Tenn., was as follows: Nothing could be found to give a clue as to the origin. The wall was quite regular in thickness and consisted only of fibrous tissue. Internal to the capsule was a single row of cells, responsible for the secretion.

The patient made an uneventful recovery and left the hospital eighteen days after the operation.

# PNEUMATIC RUPTURE OF THE BOWEL

By P. A. BENDIXEN, M. D., and J. D. BLYTHING, M. D., Davenport, Iowa

PNEUMATIC rupture of the bowel is a condition in which the bowel is inflated through the rectum by means of air under high pressure, with resulting rupture of the viscus, intra-abdominally.

The case that came under our observation is that of Paul Magdal, age 20, laborer, single, Austrian by birth; admitted to Mercy Hospital December 21, 1912, at 3:30 A. M.

Examination of patient on entrance to hospital: Patient conscious, face a little sallow and cyanotic, gasping for breath; facial expression was anxious and pinched. Enormous distention of abdomen, skin very tense; abdomen very tympanitic. Patient had very little, if any, abdominal breathing. Temperature, 98.4°. Pulse, 114. Respiration, 38. Patient was nauseated and vomited some greenish-colored material. Complained of severe griping in abdomen. Patient more comfortable lying on right side. Legs flexed on thighs, and thighs on abdomen.

Diagnosis. The diagnosis of pneumatic rupture of the bowel in this case was easily made, for the reason that a clear history of the accident was given.

Operation. Patient was given morphine gr. ¼ and atropine gr. 1/130 per hypodermic, before operation. Laparotomy was done about two hours after the accident; median line incision was made from about an inch above the umbilicus and extending almost to the symphysis. There was a little soiling of the peritoneum at the seat of a perforation on transverse colon near the hepatic flexure, and considerable amount of bloody serous exudate in the free abdominal cavity. The bowel was enormously ballooned, very little air having escaped into the free abdominal cavity. The serosa was much reddened and showed a considerable amount of injection; the sigmoid colon was ruptured along the convex border for a distance of about seven inches, with a gaping tear in its serous and muscular coats, through which the mucous coat bulged; the peritoneum was more or less ribboned throughout the entire length of the tear. The laceration on the sigmoid for the first two or three inches was virtually in a fixed part of the gut. There were three lacerations ranging from two to four inches in length on the descending colon; one large laceration about six inches long was found on the transverse colon near the hepatic flexure; in the center of this laceration we found a small perforation of the bowel. Four lacerations ranging from one to four inches were found on the ascending colon; two lacerations about two inches in length were found on the ileum about 8 inches away from the cæcum. A laceration of about 3 inches was found in the mesentery near the junction of the ileum with the cæcum, and a large blood clot was removed from the mesentery at this point. The entire colon was very much congested and more especially about the cæcum. A large number of hæmorrhagic areas, varying in size from one-fourth of an inch to three-fourths of an inch, were found in the small intestine. There was no regularity in the outline of the hæmorrhagic areas.

Technique of operation. All of the lacerations of the bowel were sutured with plain catgut. At the seat of the perforation on the transverse colon, plain catgut was used; here, however, we had to make a slight inversion of the bowel on account of the extensive laceration, and a reinforcement was made by a row of Lembert's sutures.

After tying off a few small vessels, the rent in the mesentery was likewise sutured with plain catgut.

After having examined the entire intestinal tract, the abdomen was closed, layer by layer, without drainage. Two deep silkworm gut tension sutures, over gauze rolls, were introduced. The time of the operation was one hour and thirty minutes.

After-treatment. Patient was put to bed and placed in Fowler's position. Normal saline solution was given per rectum by the drop method, one pint every four hours for the following thirty-six hours. It was necessary, however, to interrupt the saline twice during this time on account of the accumulation of gas in the intestine. On each of these occasions the administration of a turpentine and glycerine enema sufficed to bring away a large amount of flatus and the saline was then resumed. Patient was allowed to drink as much water as he desired.

On the same day at 1 P. M. the patient's temperature was 99.8°; pulse, 100; respiration, 30. The temperaturen ever exceeded 100° nor the pulse 100. This man made an uneventful recovery and left Mercy Hospital on January 3, 1913, or 14 days after the accident.

*Cause of accident.* The accident in this case was caused in the following way: the patient, a molder for one of our large foundries, had completed his work and while waiting for the furnace heat, fell asleep; a co-employee jokingly placed a compressed-air hose near his rectum and then turned on the compressed air. The air pressure at this time was estimated to be from 100 to 125 pounds. The air was forced through the clothing. The patient was immediately stricken by his internal injuries and was unable to walk after the accident.

In reviewing the literature on this subject, we found that very little has been written on

this form of injury. The only complete article was that of Dr. E. Wyllys Andrews, on "Pneumatic Rupture of the Intestine, a New Type of Industrial Accident."[1]

Since the publication of Dr. Andrews' paper, we have been able to collect seven additional unpublished cases, including our own.

CASE 1 (unpublished). History given by Mr. G. A. Orth, Chief Adjuster of the American Car & Foundry Company. Accident happened at Berwick, Pennsylvania, August 18, 1908.

Cause of the accident. The man, while working in the sandblast house, was held fast by two of his fellow-workmen, while a third employee applied the compressed air to his rectum. The victim was immediately seized with fearful griping pains in the abdomen. Patient was taken to the Berwick Hospital, where he was operated upon at once for pneumatic rupture of the bowel. Patient died three hours after the accident. Direct cause of death not given.

CASE 2 (unpublished). History given by Mr. G. A. Orth, Chief Adjuster of the American Car & Foundry Company. Accident happened at Milton, Pennsylvania, June 28, 1913.

Cause of accident. The compressed air in this case was applied, in a joking manner, to a boy, age 16, by a man. It was estimated that the air pressure in this case was about 85 pounds, the dial showing the record of the air pressure for that day in the power house to be about 100 pounds. During four or five short periods, the pressure was down to 85 and 90 pounds. The hose in this case was some distance from patient. The extent of the injury in this case was not serious and the boy returned to work shortly after the accident.

CASE 3 (unpublished). History given by Mr. R. C. Richards, General Claim Agent of The Chicago & Northwestern Railway Company. Eugene Dagenais, age 15. Date of accident, March 21, 1906, at the Chicago Railway shops.

Statement of party who applied the compressed air hose: "I was polishing some brass with a buffing wheel and I asked Eugene Dagenais to apply the air hose to me and clean my clothes, which he did; and then I served him in the same way. While placing the head of the air hose in between his legs, I must have applied it too close to his rectum, because he immediately bent forward and complained of pain. He then went to the closet downstairs, after which he went home. I have not seen him since. I did not push the head of the power air hose through his trousers, and I had only one-half of the power turned on. I do not know how many pounds I applied, but it was not very strong. We were not fooling."

In this case the boy went home on March 21, 1906, and was treated by Dr. B. of Chicago, until March 24, 1906. Patient was admitted to Francis Willard Hospital on March 25, 1906, at 8 A. M. and was operated on by Dr. A. P. H. Patient died March 25, 1906, in Francis Willard Hospital.

Post-mortem findings by Coroner Warren H. Hunter, on March 26, 1906, at Cook County Hospital: Peritoneal cavity filled with blood, fæces and a yellowish fluid. In the large intestine about 8 inches from the rectum, a linear tear, one inch long, was found. Cause of death: peritonitis and shock following external violence.

CASE 4 (unpublished). History given by Mr. Robert B. Kay, Claim Agent of The Hudson & Manhattan Railroad Company.

Accident happened at the Fifteenth Street shaft, New York, in 1905. In this case, the injured man's abdomen was ballooned by having an air hose closely pressed against his rectum. Patient received a pneumatic rupture of the bowel. Recovery was rapid and complete.

CASE 5 (unpublished). History given by Dr. J. A. Denney, Medical Director of the C. B. & Q. R. R., Chicago, Illinois. Accident happened on the C. B. & Q. Railroad.

The victim in this case was working in a bent-over position and a fellow-employee who was handling an air hose, in a spirit of mischief, pushed the air hose violently against the victim's rectum, allowing the highly compressed air to escape into the bowel. The injured man, in this case, died soon after the accident.

CASE 6 (unpublished). History given by Dr. H. C. Groman, Surgeon for the Standard Steel Car Co., Hammond, Indiana.

Patient, a boy, age 15, was injured in the Standard Steel Car Co. plant at Hammond, Indiana. The accident in this case was caused by a compressed air hose being placed to patient's rectum in a joking manner. Full pressure of compressed air was applied. The patient's abdomen was enormously distended, pain severe and continuous, pulse very rapid, heart showed signs of collapse, patient became pulseless, lost consciousness, respiration ceased and he was pronounced dead by the interne and another doctor, while Dr. Groman was introducing a rectal tube. When patient showed the above signs of collapse, Dr. Groman carefully introduced a trocar through abdominal wall and allowed the air to escape, but care was taken not to allow the air to come too rapidly in order to prevent any possible chance of a reaction.

Dr. Groman, in his communication, states the above procedure brought patient back to life, respiration returned, heart sounds and pulse improved, consciousness returned.

A laparotomy was immediately decided upon, patient was anæsthetized and the usual incision made. When the incision was made through the

[1] Surg., Gynec. & Obst., 1911, January. In this case Dr. Andrews reports a case of his own and gives a collection of 15 other cases.

abdominal wall, more air escaped from the free peritoneal cavity.

The peritoneal cavity was filled with a serous, bloody exudate, and particles of fæcal material were found. The peritoneum was ruptured in nearly every conceivable point; there were very few ruptures of the intestinal wall, the muscular layer was torn in some instances, but the serosa was extensively torn. The main laceration was near the cæcum.

Operation. The lacerations were sutured, and abdominal incision was sutured. Drainage tube was left in abdominal cavity.

After-treatment. Efforts were made to combat shock. but patient died four hours after operation.

Now, in taking up the subject of pneumatic rupture of the bowel, we note that all of these cases are the results of initiations, hazing, or carelessness on the part of the workmen with the compressed air hose. It is evident that this practical joking must be common and it is very probable that many more minor or trifling accidents have happened which are not reported. In all of the cases cited in this paper, the air had to pass through one or more layers of cloth to enter the anus. Yet this obstruction did not seem to delay its destructive or deadly work. In several cases reported by Dr. Andrews, and in some of our cases just reported, it will be noted that the compressed air nozzle was at least an inch or more from the body. Why is it, then, that we have such destructive force in the application of compressed air? First: We are personally convinced that 100 to 125 pounds of air will form a solid column of air, several inches in advance of the hose or nozzle, which would almost act like a solid body, forcing open the sphincter muscles. Second: Dr. Andrews has pointed out that the anatomical arrangement of the perineum is such as to facilitate the concentration of air pressure at the anal orifice.

This anatomical condition is a peculiar formation of the pelvic floor, forming a funnel, whose apex is at the anus; the confined air expanding in this funnel will force the gut open without having the end of the pipe accurately adjusted to the anus. With the involuntary contraction of the levator and sphincter muscles, the space between the buttocks would be narrowed and the funnel deepened, thus confining the escaping air laterally, and leading it the more quickly into the bowel.

The following is an abstract from Dr. Andrews' article in regard to the amount of pressure required to rupture an intestine: With an air pressure gauge and tank of compressed air, he showed that the ordinary bursting point in a dog or ox intestine was from six to ten pounds. The human intestine showed about the same bursting point when removed from the body. Whether the strength would be greater in the living body, we do not know, but probably there would be a slight difference. Dr. Andrews also tested numerous specimens of stomach, bladder and intestines, obtained at meat shops, and from dog experiments, and found that none of the specimens were capable of bearing over 12½ pounds, the freshest specimens bursting at about 7 or 8 pounds. Senn, experimenting on the cadaver of a case of enteritis, found that the diseased bowel ruptured at 1½ pounds.

*Pathology.* Several cases reported by Dr. Andrews speak of minor bruises about the anus. In nearly all cases reported, the pathological condition is found intra-abdominally, and consists of hæmorrhages in the serosa, lacerations of the serosa and muscular coat, with a bulging of the mucous membrane; or there may be a complete rupture of the bowel through the serosa, muscular coat and the mucous membrane.

The sigmoid, in nearly all cases, is affected. The descending, transverse, ascending colon, together with the small intestine and mesentery, may show signs of traumatic injury, due to compressed air applied through the rectum. The extent of injury to the bowel will depend upon the patient's physical condition, whether the bowel is full or empty and the amount of air pressure applied. Air is usually found in the free peritoneal cavity. Hæmorrhage and ecchymosis of the bowel are to be expected in all cases.

The symptoms in cases of pneumatic rupture will depend largely upon the extent of internal injuries, but some of the following symptoms are characteristic: First, pain is immediate, severe and continuous; second, the face is usually sallow and somewhat cyanotic, the facial expression anxious and pinched; third, the abdomen enormously

distended, skin tense, percussion note tympanitic; very little, if any, abdominal breathing, this depending upon the amount of distention; the patient may or may not be conscious. Temperature usually normal in the early stages, but in the latter stages we may have a marked temperature, due to absorption of blood and local or general peritonitis. Respirations are increased from 15 to 40 per minute; pulse rate increases somewhat, but its volume varies in proportion to the amount of internal hæmorrhage and degree of shock; nausea and vomiting are commonly present. The legs are usually flexed upon the thighs, the thighs upon the abdomen, causing relaxation of the abdominal muscles, and thereby making the patient more comfortable. In extreme cases we may have an emphysema of the surrounding structures. Rectal hæmorrhage may or may not be present.

*Diagnosis.* We believe, from the reports of Dr. Andrews, and with these additional cases, it should be possible to make a diagnosis of this form of injury, even in the absence of the history, as we may some day be confronted with an individual who is unconscious, or one who is unable to speak the English language. The following points will be of diagnostic value: First, the tense, air-filled peritoneal cavity; second, the extreme pressure on the diaphragm causing a thoracic breathing and eliminating the abdominal breathing; third, emphysema of the tissues as reported in some of Dr. Andrews' cases without signs of inflammation; fourth, the common general symptoms of an abdominal injury.

Differential diagnosis would have to be from ileus, perforation, ulcer or wounds, fractures of the ribs or injury to the air passage, causing an emphysema.

*Prognosis.* In combining our cases with those of Dr. Andrews, we arrive at the following results:

Cases not operated upon show a recovery of 8.6 per cent.

Mortality in operative cases, 39.1 per cent.

In those cases operated upon the percentage of recovery is 21 per cent. This preponderance of deaths over recoveries in the cases operated upon must be explained by the failure in so many instances to make an early diagnosis, and more especially to resort to an early operation.

*Treatment.* Conservative treatment in these cases should not be considered. It may be necessary in some cases to institute a preliminary introduction of a trocar through the abdominal wall, under aseptic precautions, to permit the escape of sufficient air from the free abdominal cavity to facilitate later operative procedures. No attempt should be made to wash out the bowel prior to operation. The condition should be treated as a rupture of the intestines from blows and the earliest possible exploratory operation should be done.

The lacerations and perforations should be sutured and, if large amount of fæcal material is present in the free peritoneal cavity, a drainage tube should be inserted.

*Post-operative treatment.* Patient should be placed in Fowler's position. Normal saline by the drop method should be given per rectum and all further treatment should be directed toward meeting the symptoms as they arise.

A paretic condition of the bowel may be expected. The rectal tube and turpentine or glycerine enemas will be found useful in relieving the patient from the oppression of gas.

In conclusion, we want to impress upon you the following: First, that compressed air is a very universal necessity in modern industries; second, a strong warning verbally and by prominently displayed signs should be given each foreman and employee against all practical joking, or hazing, with the air hose; third, that air rushing from a compressed air hose can enter the body through the clothing and cause serious laceration of the bowel, proving fatal in many instances; fourth, that the diagnosis of this accident should be made from the physical signs alone; fifth, that the sigmoid is the most common seat of injury.

In closing this paper we desire to express our thanks to those who have enabled us to collect the histories of the above cases, and to acknowledge our indebtedness to Dr. Andrews, from whose pioneer article on this subject we have so freely drawn.

Since this article was submitted for publication the following additional case has been reported to us by Dr. Paul M. Mecray, of Camden, New Jersey:

On July 24, 1913, a robust Italian boy, aged 17, employed by a large wood-working establishment, was frolicking with some other boys during the noon hour. One of them seized a compressed-air hose which was used for clearing the bench of sawdust, and applied the nozzle to the rectum of the victim. The maximum pressure employed in this plant was eighty pounds to the square inch, but the shop superintendent estimated that at the time in question the pressure was not above ten pounds.

The investigation showed that the hose was held several inches from the anus, and that the air passed through trousers and drawers. When the boy was admitted to the hospital the following note was made by the resident, Dr. T. M. Kain:

"Patient was brought to hospital in ambulance at 1:40 P. M. The only history obtainable was to the effect that patient while sitting on a box had suddenly fallen to the floor. Upon arrival at the hospital he was found to be dead.

"Examination showed no visible marks of injury; no lacerations, bruises, no fractures. There was a small abrasion on the lip, and the tip of tongue. Abdomen was markedly distended and there seemed to be free air in the abdominal cavity. Air was also present in subcutaneous tissue all over the body, very pronounced in the pectoral regions."

At the necropsy conducted by County Physician Frank O. Stem and Dr. Mecray, the tissues about the anus were found to be ecchymosed, and the anal sphincter stretched so as to admit four fingers. There was general emphysema. On opening the abdominal cavity air escaped under great pressure. The colon was ruptured in eight places and showed the effect of stretching before rupture occurred. There was general venous engorgement, and many ecchymotic areas scattered through the small bowel.

# AN ARTIFICIAL URETER MADE FROM THE ABDOMINAL WALL[1]

## A Preliminary Report of an Experimental Study

By ALFRED A. STRAUSS, M. D., Chicago
From the Department of Experimental Surgery, Morris Institute for Medical Research of the Michael Reese Hospital

MANY attempts have been made by various investigators to replace a portion of the ureter which has been destroyed anatomically and functionally by inflammation, stones, benign or malignant tumors.

Prominent among the surgeons who have attempted a solution of this problem are Casati, Boari and Israel, who used tubes of silver, glass and caoutchouc. Casati, Boari and Van Hook cut a flap out of the bladder and sutured it in the shape of a tube to the proximal end of the ureter. Rydygier did the same with a flap of skin. Fenger and Bacon, Poggi and Tizzoni, D'Urso and DeFabi, Esau and Moskowicz employed loops of the intestine separated from the rest of the bowel, but still attached to their mesentery, while Giannettasio, Rydygier and Franke transplanted the appendix in the same way, and D'Urso, DeFabi, Flörcken and Stubenrauch used the uterine horns of bitches. The function of the ureters was generally impaired or destroyed because of the frequent stenosis and infection, but the transplantation of the uterine horns gave better results.

In 1908 Melchior, and afterwards Rich, Holbauer and Klepp, tried to replace in dogs a piece of ureter with various blood-vessels. Tietze and Flörcken soon found the transplanted vessel replaced by connective tissue. Chiasserini and Dominici used external jugular, femoral and saphenous veins and sometimes the carotid artery. They came to the following conclusions:

"1. There is a possibility of the vessel introduced between the ureteral ends becoming firmly united to them.

"2. A few days after the operation the piece transplanted becomes shortened so as to draw the two ureteral ends nearer together.

"3. The graft becomes thicker and harder, while the lumen is nearly obliterated.

"4. The stenosis causes a stoppage in the flow of the urine with consecutive dilatation of the canal of the ureter and hydronephrosis."

It will be noticed from the above that the various structures and organs used for transplantation have very important physiological functions. To destroy or sacrifice such an organ or structure for transplantation to another organ is not very practical.

For this reason, and in order to make a transplantation that is practical, I have tried to keep my work within the limits of the following principles:

1. The part or structure used shall be adjacent and along the line of the ureter.

2. The part or structure used for transplantation shall have no important physiological function, nor be part of an important or vital organ.

3. The transplant used shall retain two of its most important physiological requirements in order that it may remain in its highest state of resistance, namely, a definite nerve and blood supply.

With the above facts in mind, the following surgical procedure was carried out: An incision was carried from one-half inch below the angle of the twelfth rib in the midaxillary line downward to within one inch medianward of the anterior superior spine of the ilium. The muscles were divided down to the transversalis. The internal oblique was divided and dissected back as far as its iliolumbar fascial attachment laterally and medianward to the belly of the rectus muscle. This exposes the transversalis muscle, as shown in Fig. 1, with its blood and nerve supply, the anterior branches of the lumbar arteries and nerves.

A flap was now made, as is shown by the dotted line in Fig. 1, which includes the transversalis muscle, fascia and peritoneum. The peritoneum, fascia and muscle were closed

[1] Accepted for publication October 31, 1913. Read before the Chicago Surgical Society, November 7, 1913. (See discussion p. 122.)

with one suture starting at the superior angle of the pedicle of the flap, and while suturing the pedicle the sutures only penetrated the peritoneum and transversalis fascia, as shown in Fig. 2.

The operation is now absolutely extraperitoneal. The ureter was exposed in the region of the flap and the two small ureteral arteries, which are on each side of the wall of the ureter, were tied with fine arterial silk at both the distal and the proximal ends. Two or three inches of the ureter were next resected. A temporary ligature was placed on the proximal end of the ureter. The lower free edge of the flap was picked up and the peritoneum and transversalis fascia separated from the transversalis muscle for about 0.5 cm. An end-to-end anastomosis with the distal end of the ureter was made in such a way that the fascia and peritoneum were slightly within the ureter and the muscle without, as shown in Fig. 3.

The proximal end of the ureter was placed on the upper portion of the flap and an end-to-end anastomosis made by a continuous circular suture. Here, however, the peritoneum is not within the lumen of the ureter (Fig. 4). The edges of the flap were closed to complete the tube, using a continuous over-and-over suture going upward and crossing this with a suture downward, so as to make a figure X (Fig. 5). Fine arterial silk was used for the anastomosis and flap closure. The temporary ligature was removed and the artificial ureter as well as the ureter below the anastomosis became distended with urine and the rhythmic ureteral wave passed on over the ureter. A fine rubber drain was left in the wound for the first few days to allow for the slight leakage of urine that might occur.

At the end of seven months one of the dogs was anæsthetized and opened. The pedicle of the flap was normally intact. The artificial ureter was shortened to about one-third its original length so as to draw the ureteral ends nearer together. The circumference and lumen of tube were of the same size as when first constructed. The tube as a whole felt hard and non-compressible. The peritoneum was adherent to it on one side and to the internal oblique on the other. Many well-defined blood-vessels could be seen adjacent and in the adherent tissues. The ureter was now divided three inches below the distal anastomosis and urine came through in jets in about normal quantity.

The specimen was removed and an opening made in the ureter about one inch above the proximal anastomosis. A probe could be passed with ease through the artificial ureter and its anastomoses and also a second smaller probe could be passed alongside of it. The hardened artificial ureter was opened with scissors. It cut with difficulty. Its inner surface appeared smooth and had the appearance of a lining membrane. The body of the tube felt hard. This we assumed to be due to infiltration of calcium and urinary salts. The anastomoses showed no evidence of contraction or stenosis. The kidney showed no changes.

Six and one-half months after operation dog No. 2 was anæsthetized (Fig. 6). The artificial ureter showed the same hardness and shortening as in No. 1. This time the bladder was opened and the papillæ examined. The urine came through the ureter, but not as freely as No. 1. The papillæ appeared normal. On opening the artificial ureter, a fair sized calculus was found lodged in the distal anastomosis. This calculus had the end of a fine silk thread as its nucleus and undoubtedly produced the partial obstruction and a corresponding dilatation of the ureter and hydronephrosis. The anastomoses, however, showed no contraction and the lumen of the artificial ureter was of the same size as originally made.

Dog No. 3 was anæsthetized six months after operation and showed the same as No. 2. Here the artificial ureter was so large as to form a pouch, which caused a slight dilatation of the ureter and a hydronephrosis, but no stenosis of anastomoses. In this experiment the artificial ureter was made exceptionally large, which accounts for the pouching.

Dog No. 4, which was very small, was examined five and one-half months after operation. A contraction was found and an almost complete obstruction of the lower anastomosis and a marked dilatation of ureter and hydronephrosis.

*Histology.* A section of the artificial ureter was taken from each of the above specimens. The portion taken was midway between the proximal and distal anastomoses and showed: (1) in place of the peritoneum a typical transitional epithelium together with its basement membrane, outside of which is a thin layer of areolar tissue. (2) In place of the transversalis fascia a layer of bone was seen well organized with typical osteoblasts, blood-vessels and lymph-vessels. (3) The transversalis muscle showed no changes. The epithelium is probably a proliferation of the epithelium from the ureter, since it is of the transitional type and has the same appearance as that in the ureter proper. The basement membrane of the peritoneum acts as a matrix for its implantation. The transformation of the transversalis fascia into cartilage in the earlier stages and into bone in the later stages is explained on the following embryological and chemical basis.

*Embryology.* The abdominal wall is formed originally from the mesoblastic somites, the median portions of which lie in immediate contact with the notocord and are known as the sclerotomes. They grow inward toward the median line surrounding the spinal cord and forming the vertebræ, while the lateral portions of the mesoblastic somites form the musculature and are known as the myotomes. These lateral portions grow ventrally until they meet in the midline their fellows of the opposite side. Thus we see the vertebræ and abdominal musculature formed from one embryological layer and structure—the mesoblastic somites.

*Chemistry.* The flap in its original position is in contact with a neutral media, the peritoneal fluid and alkaline reaction of the blood and lymph. When transplanted it comes into contact with the urine, which is acid, due to the acid sodium phosphate content. The tissues probably become infiltrated with this acid medium, which produces a sclerosis, and according to H. Gideon Wells, calcification and ossification commonly occur in tissues which have an excess of acid present. The cartilage stage, which is seen in the dog five and one-half months after operation, also speaks in favor of this hypothesis. Cartilage, which is the favorite site of calcium deposits, takes on a basic stain implying that it is of an acid reaction, and this in turn is probably due to the presence of chondroitin sulphuric acid. The flap, which originally had a definite blood supply, is reinforced by new blood-vessels, as may be observed in the histological sections. We know the plasma from the blood and body fluids furnishes calcium which infiltrates the cartilage to form bone, which is seen in the later stage in sections (Fig. 11). Thus we note on the one hand the acid infiltrated tissues showing slight degenerative changes due to the irritating action of the urine, forming an acellular matrix of cartilage; on the other, the body fluids which infiltrate the cartilaginous matrix with calcium, converting it into bone. These two facts, together with the osteogenetic potentiality inherent in this particular group of muscles and fascia, account for the transformation of the transversalis fascia into a bony plate.

The histological sections show that practically few or no degenerative changes have taken place where the bone is formed. This is in marked contrast to the process involved in pathological bone formation, in which a granular detritus becomes infiltrated with calcium, then undergoes vascularization and is changed into bone. Our own sections, however, show a bone formation closely resembling that of normal bone, with a cartilage stage, then a calcium infiltration and finally a bone formation. It will also be noted in these sections that the bone contains many large blood-vessels and lymph spaces; the transversalis muscle which surrounds the bony plate is also well preserved and highly vascularized, all of which speaks largely against a degenerative process of any extent having taken place.

To strengthen the above hypothesis of bone formation, and to show that it is not unusual for bone to be found in the body irrespective of its proximity to bone tissue, I will cite a report of autopsies by Poscharissky. In 29 cases of calcified areas in the eyeball following suppuration, bone was found in 25 of them. Calcified nodules from the lungs of 28 persons were examined and in 17 of them bone was found. In 3 of 14 calcified nodules of heart

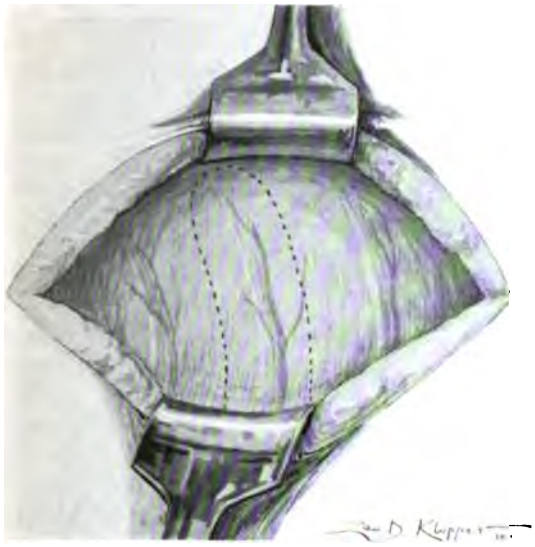


Fig. 1. Operative procedure.

Fig. 2. Operative procedure.

valves, bone was present. Calcified nodules in the liver and in the mesenteric glands are also often ossified, and, in fact, there is hardly a tissue in the animal body in which the transformation of calcified into ossified tissue has not been observed.

The explanation of this pathological bone formation is given by H. Gideon Wells in his classic monograph on ossification and calcification as follows: "The process by which these inert, dead calcified areas are converted into living bone tissue is entirely analogous to the normal formation of bone in endochondral ossification. The calcified material simply takes the place of the primordial cartilage, vascular granulation tissue eroding it and the cells of the granulation tissue undergoing a differentiation into osteoblasts which constitute an osteogenetic layer and form the new bone. When there is no preliminary calcification of a necrotic tissue we get no subsequent ossification, and it seems that the calcium salts exert a specific influence on the connective-tissue cells which causes them to take on active growth and to undergo a metaplasia not only into osteoblasts and bone corpuscles, but apparently even into marrow."

Liek was able to obtain bone formation constantly in the pelvis of the rabbit's kidney within sixteen to twenty days after ligating the renal artery provided he wrapped the kidney with omentum to secure a free collateral circulation. Without this collateral circulation it requires about three months for ossi-

Fig. 3. Operative procedure.

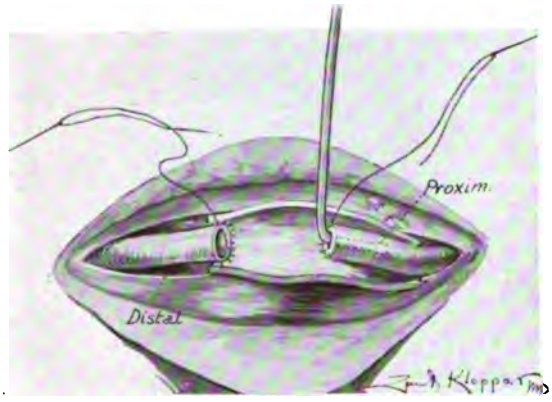



Fig. 4. Operative procedure.

fication to appear. These and other experiments by the same author show that the amount of blood supply is an important factor in determining pathological ossification. With too free a circulation, there is no calcification and no ossification. With too little circulation, necrosis is followed by slow calcification and either late or no ossification. Liek's experiments on rabbits, which have a neutral or alkaline urine, throw some doubt on the acid urine infiltration theory. So it is possible that some other chemical factor produces this irritation or that the tissues are in contact with an unaccustomed chemical medium.

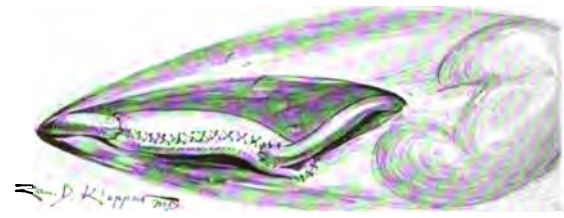


Fig. 5. Operative procedure.

The same surgical procedure was tried on the common bile duct but with indifferent results. This was undoubtedly due to the difficulty with which the anastomosis was made. We have also some living dogs, operated three months ago, in which a free transplant was used instead of a pedicle transplant. The results of the latter will appear in the near future.

## CONCLUSIONS

1. The flap from the abdominal wall forms a patent non-collapsible bony tube lined by

Fig. 6. Six and one-half months after operation.

Fig. 7. Five and one-half months after operation.

Fig. 8. Six months after operation.

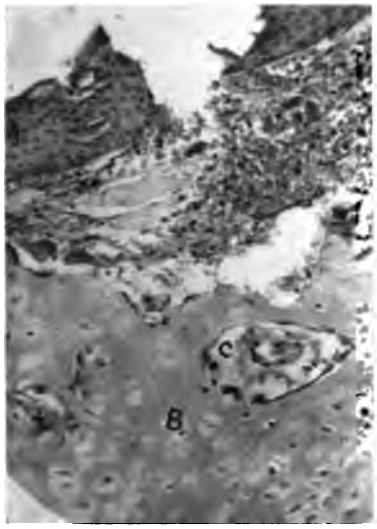



Fig. 9.

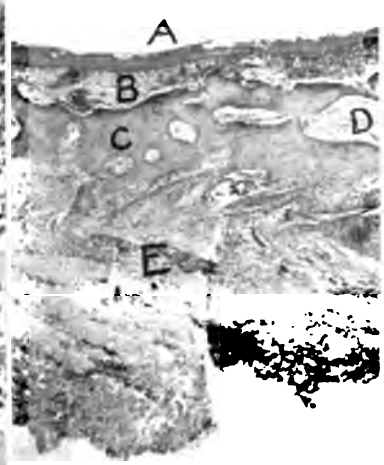



Fig. 10.

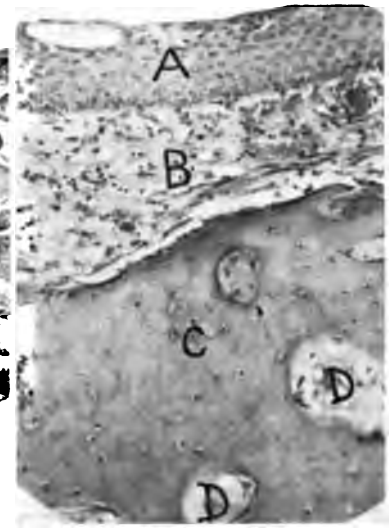



Fig. 11.

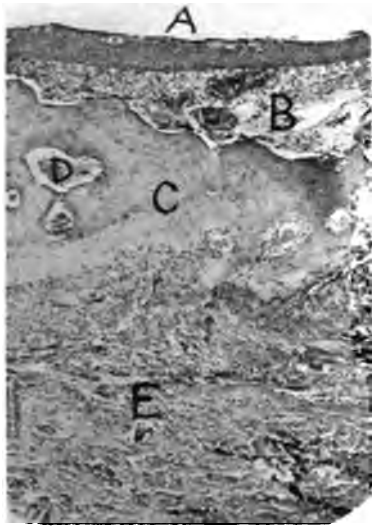



Fig. 12.

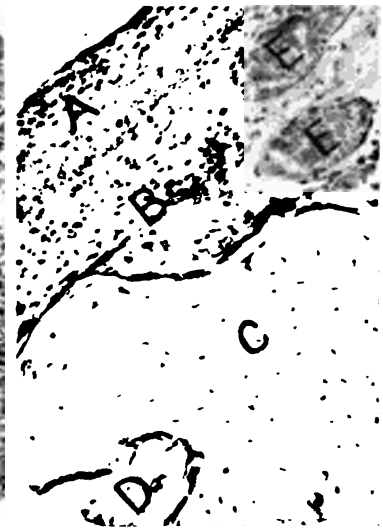



Fig. 13.

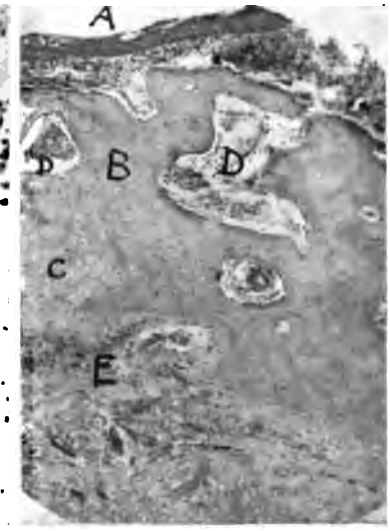



Fig. 14.

Fig. 9. Section showing cartilage. A, transitional epithelium; B, cartilage; C, blood-vessel.

Fig. 10. A, epithelium; B, areolar connective tissue; C, bone; D, blood-vessels and lymph spaces in bony plate; E, transversalis muscle.

Fig. 11. Fig. 10 under high power. A, transitional epithelium; B, areolar connective tissue; C, bone; D, blood-vessels.

Fig. 12. A, epithelium; B, areolar connective tissue; C, bone; D, blood-vessels in bony plate; E, transversalis muscle.

Fig. 13. Fig. 11 under high power. A, epithelium; B, areolar connective tissue; C, bone; D, large blood-vessel; E, blood-vessels in areolar connective tissue.

Fig. 14. A, epithelium; B, bone; C, cartilage remaining in bony plate; D, blood-vessels; E, transversalis muscle.

transitional epithelium and covered by the transversalis muscle.

2. Anastomosis remains patent on account of the non-collapsibility of the bony tube and the hydrostatic pressure within the ureter.

3. Hydronephrosis occurred in several cases: in one due to a calculus; in another due to the pouching of too large an artificially made ureter, and probably the interruption of the ureteral peristaltic wave.

I wish to thank Dr. J. W. Jobling and Dr. E. Kirk for the valuable advice and suggestions they have given me while carrying on this work.

---

# THE RELATION OF MULTIPLE ADENOMATA TO THE ETIOLOGY OF THE ENLARGEMENT OF THE PROSTATE GLAND

By JAMES A. GARDNER, M. D., and BURTON T. SIMPSON, M. D., Buffalo, New York

IN 1911 one of us, in studying the growth centers of the benign adenomata of the thyroid and prostate glands, was struck by the frequency with which these tumors were the apparent cause of the enlargement of the prostate gland, and also by the fact that one could find isolated small adenomatous nodules in normal sized prostates before the so-called hypertrophic age, namely, between forty and sixty years of age.

In reviewing the literature of prostatic hypertrophy it was surprising to find that English and American authors were not inclined to accept true adenoma formation as an important factor in the etiology of this condition. In the first paper only seven enlarged prostates were studied, but from the fact that the entire seven showed adenomatous enlargement, it occurred to us that a study of a greater number of glands would give valuable information concerning this factor in the etiology of this condition.

In reviewing the literature one finds a great diversity of opinion regarding the genesis and pathological anatomy of the condition commonly called prostatic hypertrophy.

Virchow (1) taught that the so-called hypertrophy should be separated into two classes, one belonging to the myomata and the other to the gland tumors, from which we must conclude that he considered the enlargement of the prostate as a true tumor formation.

Billroth (2) wrote that, in so far as his investigations went, prostatic hypertrophy was never connected with adenoma formation, but was a dilatation of the acini with perhaps some hyperplasia. He believed that nodular or diffuse myoma formation was common.

According to Socin (3) prostatic hypertrophy is a name given to a variety of pathological conditions having in common the enlargement of this gland. In his opinion the ordinary enlargement is neither of inflammatory origin nor a true hypertrophy, but a true tumor formation.

Cohnheim (4) stands out definitely for the tumor theory, as may be concluded from the following: "The new growth which one commonly calls hypertrophy of the prostate is neither inflammatory tissue nor, notwithstanding its name, legitimate hypertrophy, but true and undoubted tumor formation."

Lannois (5), a pupil of Duyon, did not consider senile prostatic hypertrophy as true tumor formation, but as a part of an extensive arteriosclerotic process which begins in the kidneys and extends throughout the entire genito-urinary system.

Rindfleisch (6) assigned the cause of prostatic enlargement to tumor formation. He described two forms, the more rare fibrous, accompanied with atrophy of the glands, and the much more common form, namely, the discrete nodular adenomatous.

Birch-Hirschfeld (7) considered the enlargement of this gland as an expression of new growth, and assigns its origin to the budding of the gland tubules.

Lydston (8) believed that prostatic hyper-

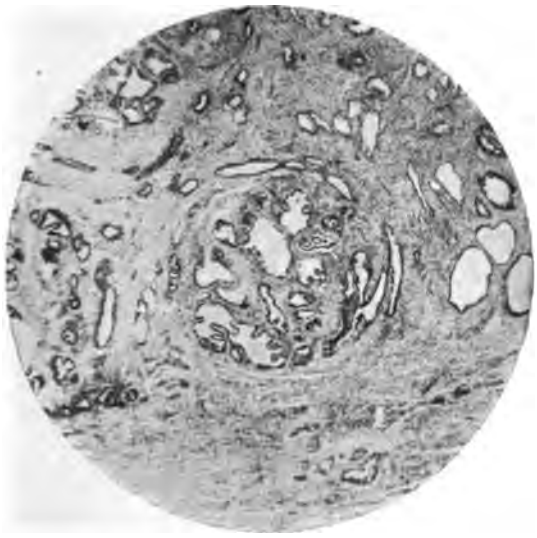


Fig. 1. Early isolated adenoma, with a slight indication of capsule, with connective tissue and gland substance becoming compressed.

Fig. 2. Same as Fig. 1, but a later stage.

trophy began in the period of sexual activity and was the result in the majority of cases of sexual excesses.

Jores (9) called attention to the fact that apparently hypertrophy of the so-called middle lobe took its origin in the suburethral accessory glands.

Aschoff (10) demonstrated these suburethral accessory glands not only in the males but also in females in the new-born.

Ciechanowski (11) wrote a voluminous article supporting the inflammatory theory of prostatic enlargement, particularly emphasizing the part played by gonorrhœa. He believed that a long-continued chronic inflammation was the basis of the changes which take place in prostatic hypertrophy. He admits that true adenomata and myomata may occur rarely, but they have nothing in common with prostatic hypertrophy.

Beginning with Albarran (12), the majority of French investigators, Motz and Perearnau (13), Marion (14), Marquis (15), and Chevassu (16), hold that prostatic enlargement is due to true tumor formation, their only difference of opinion being in regard to whether they take their origin solely from periurethral accessory glands or whether they may spring from any part of the gland itself.

Stoker (17) does not believe in the so-called middle lobe, but holds that the enlargements which occur at the proximal urethral orifice are caused by either myomata or adenomata. The enlargement of the gland proper he considers as a true hypertrophy, which may be associated with encapsulated adenomata.

Rotschild (18) advocated the inflammatory theory and believed the enlargement was due to dilatation of the acini caused by obliteration of the excretory ducts. Bangs also upholds this view, although he believes that gonorrhœa plays little or no part in the process, but would emphasize the factor of long-continued congestion which occurs in long-continued and often repeated sexual excitement.

Wichmann (19), in an investigation of the etiology of prostatic enlargement, concluded that inflammation plays little or no part in the production of this condition.

Wallace (20), Tietze and Lendorf (21) accept prostatic enlargement as adenoma formation, the latter holding that the tumors always spring from the periurethral accessory glands.

Alexis Thomson (22), in a series of ninety enlarged prostates, wrote that he had never met with an encapsulated adenoma or fibroadenoma, and doubts if such exists. He believes the enlargement to be due to diffuse

Fig. 3. Cross section of prostate in region of colliculus showing isolated nodule in lateral lobe.

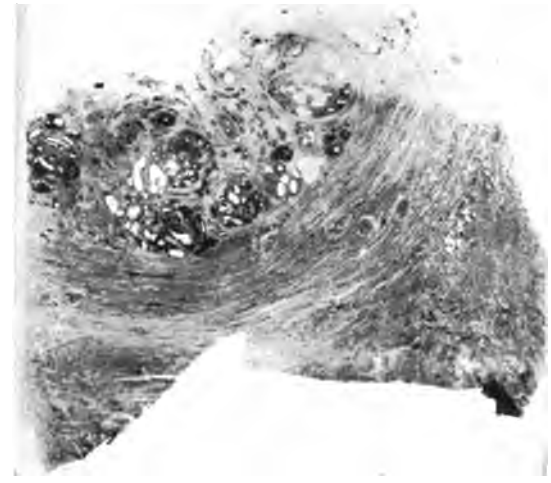


Fig. 4. Showing multiple adenomata in prostate.

hyperplasia of both the gland and musculofibrous tissue.

Von Frisch (23) declares that we can only conjecture concerning the cause of these idiopathic tumor formations, the definite cause being unknown.

Adami and Nichols (24) teach that while prostatic hypertrophy may precede the development of definite neoplastic conditions within the organ, it must nevertheless be sharply distinguished from the same. "With the more recent authorities we should regard it as the outcome of a long-continued, chronic inflammation, more particularly involving the urethral portion of the gland."

Simmonds, in Aschoff's Pathological Anatomy, writes that the more recent thought concerning prostatic hypertrophy gives a very subordinate place to the inflammatory, and considers the enlargement of this organ to be due to true tumor formation.

G. Cuttat (25) in 1912, in summing up his studies on the etiology of prostatic hypertrophy, writes as follows:

"(1) Etiologically speaking it is not possible for us to admit that an infection leading to chronic inflammation can explain prostatic hypertrophy.

"(2) That hypertrophy of the prostate does not enter into the category of true tumors.

"(3) The prostatic hypertrophy is a true fibro-epithelial degenerance which finds its analogy anatomo-pathologically in fibro-epithelial tumors of the thyroid and breast, the glandular and connective-tissue elements taking nearly equal parts in augmenting the volume of the gland, the cellular infiltration being of secondary origin."

In summing up this review of the literature one must admit that there is a diversity of opinion concerning this pathological process. It would appear that the more recent investigators are in accord with the view that the condition is a new growth. The discussion at present seems to be concerning the origin of these tumors. For instance, Motz, Marion, Marquis, and Lendorf believe that these adenomata always arise from the periurethral accessory glands, while Chevassu writes a paper the sole object of which is to refute this theory, which he says is against the teachings of his master, Albarran. On the other hand, Tandler and Zuckerkandl (26) believe that prostatic hypertrophy always takes its origin from the middle lobe, which they describe as that part of the prostate which lies between the urethra and the ejaculatory ducts.

The material for our study consists of one hundred prostate glands, eighty of which were obtained at autopsy and twenty from operation.

The ages of our cases are shown in the following table:

Fig. 5. Section of half a prostate showing large adenomata lying outside of fibromyoma.

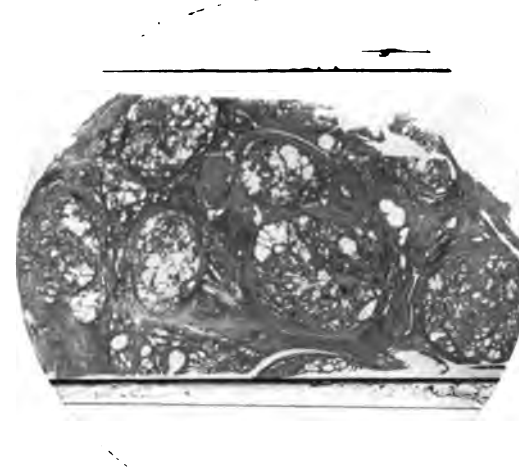


Fig. 6. Section of prostate showing multiple adenomata well isolated and marked off by distinct capsule.

TABLE NO. I

| | | | | | AUTOPSY | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Age | 1–10 | 10–20 | 20–30 | 30–40 | 40–50 | 50–60 | 60–70 | 70–80 | 80 | Total |
| No. | 2 | 3 | 3 | 7 | 19 | 21 | 18 | 6 | 1 | 80 |
| | | | | | OPERATION | | | | | |
| No. | ... | ... | ... | ... | ... | 1 | 12 | 15 | 2 | 20 |

That prostatic enlargement may occur as the result of the dilatation of the acini or from other of the causes assigned to it is not denied here; but that eighteen of the twenty enlarged prostates which occurred in our series were the result of true adenomata formation there can be no doubt, and we believe the majority of enlarged prostates are due to this cause. There are many circumstances which lead one to this conclusion. In the first place it is against pathological principles to expect true hypertrophy at the time of life when enlargement of this gland occurs. As a matter of fact the prostates in our series that did not show adenomatous enlargement at this age showed atrophy. On the other hand, we find benign neoplasms at this age, as is illustrated by the adenomata of the thyroid and myomata of the uterus.

Many other theoretical considerations could be advanced. But what is more essential is the demonstration of the development of these adenomata from tiny isolated nodules to an enlarged gland filled with such tumors.

If we study a series of prostates of men between the ages of forty and sixty we are enabled to demonstrate such a development as has been heretofore spoken of.

Of the exact origin of these nodules we know as yet very little. Various investigators have explained their origin in various ways. For instance, Motz, Marion, Cuneo and others believe that these adenomata always have their origin in the periurethral accessory glands. Birch-Hirschfeld describes them as being the result of budding of the gland tubules. Tietze believes that these tumors spring from isolated nodules which are separated from each other by loose connective tissue. Chevassu does not agree with some of his confreres in regard to the periurethral glands as being the sole place of origin of these tumors, but believes that they may arise from any portion of the gland. We are in accord with Chevassu in this regard, for we have found adenomatous nodules in the so-called surgical capsule, which also disproves Tandler and Zuckerkandl's theory that prostatic hypertrophy always begins in the middle lobe. Besides this we have found normal gland tissue between the adenomata. Personally we are inclined to believe that these tumors originate from isolated glandular tissue, and that this may occur in any part of the prostate gland.

We think that by studying the following

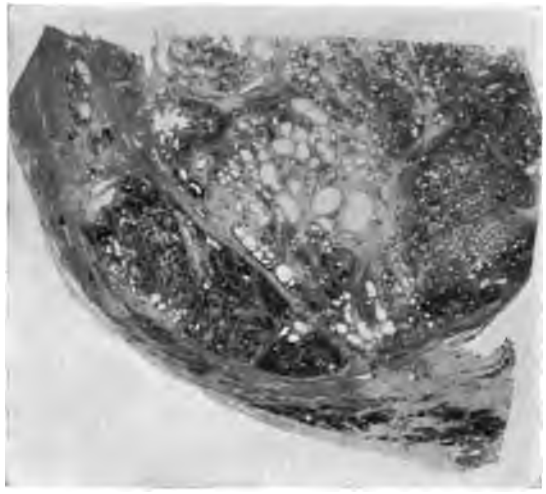


Fig. 7. Lower left quadrant of enlarged prostate showing multiple adenomata.

table one may draw interesting conclusions.

TABLE NO. 2

| | AUTOPSY | | | | | | | | Totals |
|---|---|---|---|---|---|---|---|---|---|
| Ages | 1–10 | 10–20 | 20–30 | 30–40 | 40–50 | 50–60 | 60–70 | 70–80 | 80–90 | |
| Normal | 2 | 3 | 3 | 6 | 14 | 14 | 13 | 2 | | 57 |
| Adenoma | ... | ... | 1 | 5 | 7 | 5 | 4 | 1 | | 23 |
| | OPERATION | | | | | | | | | |
| Myoma or interstitial proliferation | | | | | ... | 2 | ... | ... | | 2 |
| Adenoma | ... | ... | ... | ... | 1 | 10 | 5 | 2 | | 18 |
| | AUTOPSY PAST 40 YEARS | | | | | | | | | |
| Normal | ... | ... | ... | 14 | 14 | 13 | 2 | ... | | 43 |
| Adenomata | ... | ... | ... | 5 | 7 | 5 | 4 | 1 | | 22 |

In studying the fifteen prostates between the ages of one and forty, only one (thirty-eight years) was found in which adenomatous nodules were present. Between forty and sixty, twelve were found which contained these nodules, or forty-three per cent. While in the twenty-four prostates between sixty and eighty, but two (61 and 63 years) were found that contained only isolated nodules, the others being adenomatous enlargement. We may assume from these facts that between the ages of forty and sixty is the common period of the first appearance of these nodules, or the beginning of prostatic enlargement. In the period between sixty and eighty, these nodules reach their maximum and produce the clinical symptoms which we recognize as prostatic hypertrophy. If we consult Table No. 3, we will notice that the prostates in this series

TABLE NO. 3

| Age | 40–60 | 60–80 |
|---|---|---|
| Isolated Adenoma | 12 | 2 |
| Adenomatous enlargement | 1 | 7 |
| Normal[1] | 29 | 10 |
| Atrophy | 0 | 6 |

[1] Normal as regards adenoma formation.

of individuals between sixty and eighty show one of three conditions, viz., adenomatous enlargement, an atrophy, or were normal.

In studying adenomata of the prostate gland it is necessary that one use the lowest power lenses on the microscope or a simple lens. The most convenient is the dissecting microscope. By this method it is very easy to pick out these little nodules from a slide containing a cross section of the prostate. In the younger nodules one is attracted by a round or oval, deeply-stained nodule around which can be seen a thickening of the adjacent tissue (Fig. 1). Fig. 2 shows a little later stage in the development of these adenomata. The epithelium has proliferated and resembles the normal epithelium of the prostate when seen with the higher powers of the microscope.

The interstitial tissue varies from the normal in that there is a marked preponderance of the connective-tissue element. One notes already the compression of the surrounding normal prostatic tissue with its low epithelium, which is in marked contrast to the high columnar of the adenomata. Fig. 3 depicts a still later stage in the development. In this section we note that the epithelial element predominates, also at the sides we can see the compressed normal prostatic tissue.

In conclusion we would say that so far as our research with enlarged prostates reaches, the condition in the majority of cases is caused by the growth of multiple adenomata.

NOTE. The so-called surgical capsule made of compressed prostatic gland and containing a distinct small adenoma. This demonstrates the fallacy of Tandler and Zuckerkandl's theory that the prostatic enlargement always springs from middle lobe.

## BIBLIOGRAPHY


1. VIRCHOW. Die krankhaften Geschwülste, 1863, iii.
2. BILLROTH. Chirurgische Pathologie und Therapie, 1869, 683.
3. SOCIN. Krankheiten der Prostata, Pitha-Billroth, Handbuch der Chirurgie, 1871–75, iii, 8.
4. COHNHEIM. Allgemeine Pathologie, 1877.
5. LANNOIS. De l'appareil urinaire des vieillards. Thèse de Paris, 1885.
6. RINDFLEISCH. Pathologische Gewebelehre, 1886.
7. BIRCH-HIRSCHFELD. Pathologische Anatomie, 1887.
8. LYDSTON. The Etiology of Prostatic Hypertrophy Phila. Report, 1893.
9. JORES. Über die Hypertrophie des sogenannten mittleren Lappens der Prostata. Arch. f. path. Anat. u. Physiol. u. f. klin. Med., Berl., 1894, cxxxv, 224.

10. ASCHOFF. Ein Beitrag zur normalen und pathologischen Anatomie der Schleimhaut der Harnwege und ihrer drüsigen Anhänge. Arch., f. path. Anat. u. Physiol. u. f. klin. Med., Berl., 1894, cxxxviii.
11. CIECHANOWSKI. Anatomische Untersuchungen über die sogenannte "Prostatahypertrophie" und verwandte Prozesse. Mitt. a. d. Grenzgeb. d. Med. u. Chir., 1900, vii.
12. ALBARRAN, LE DEUTA and DELBET. Topographie normale des glandes de la portion prostatique de l'urètre. Traité de chirurgie clinique et opératoire. 1900, ix, 526.
13. MOTZ and PEREARNAU. Contribution à l'étude de l'évolution de l'hypertrophie de la prostate. Ann. d. mal. d. org. gen.-urin., 1905.
14. MARION. Betrachtungen über den Ursprung der sogenannten "Prostatahypertrophie." Ztsch. f. Urol., 1911, v.
15. MARQUIS. Rev. de Chir., Par., 1910.
16. CHEVASSU. L'origine anatomique de l'hypertrophie prostatique. Bull. Soc. anat. de Par., 1911, Nov.
17. STOKER. Observations on Suprapubic Prostatectomy. Brit. M. J., 1904, 229.
18. ROTSCHILD. Arch. f. path. Anat. u. Physiol. u. f. klin. Med., Berl., clxxiii.
19. WICHMANN. Anatomische Untersuchungen über die Etiologie der Prostatahypertrophie. Arch. f. path. Anat. u. Physiol. u. f. klin. Med., Berl., clxxviii.
20. WALLACE. An Anatomical Criticism of the Procedure Known as Total Prostatectomy. Brit. M. J., 1904. 230.
21. TIETZE. Über atypische Epithelwucherung in der hypertrophischen Prostata. Beitr. z. klin. Chir., 1911, lxxvi.
22. THOMSON, ALEX. Anatomy of the Enlarged Prostate, etc. Edinburg med. chir. Soc., Brit. M. J., 1904, 1372.
23. VON FRISCH. Die Krankheit der Prostata, Spezielle Pathologie u. Therapie, Nothnagel, 1910.
24. ADAMI and NICHOLS. Principles of Pathology, 1911, ii.
25. CUTTAT, G. De l'étiologie de l'hypertrophie. Rev. méd. de la Suisse Rom., 1912, No. 10, Oct.
26. TANDLER and ZUCKERKANDL. Anatomische Untersuchungen über die Prostatahypertrophie, etc. Folia urol., 1911, v.

# DEPARTMENT OF TECHNIQUE

## THE TREATMENT OF RECURRENCES AND METASTASES FROM CARCINOMA OF THE BREAST[1]

By GEORGE E. PFAHLER, M. D., PHILADELPHIA
Professor of Röntgenology in the Medico-Chirurgical College

THE group of patients indicated by the above title are usually regarded as hopeless, and at present we must admit that no method of treatment is entirely satisfactory. Some remarkable results have been accomplished by the methods that I shall describe, but these results are far from ideal, and in the end failure is the rule, and complete success is the exception. Even with this dismal introduction, I am not without hope. More has been accomplished by radiotherapeutic measures than by any other method of treatment of this group of cases. The partial success obtained may point the way to complete eradication of the disease, and permanent cure.

### GENERAL REMARKS ON THE METHOD OF TREATMENT

In general, the treatment has consisted in the application of the röntgen rays as promptly and as vigorously as possible after the patient has been first brought to my attention. The rays have been applied from as many directions as possible, and carried to the limit of skin toleration, after filtration. To this has been added every measure that would tend to improve the patient's general health, so far as circumstances would permit. Combined with the above results I have added small doses of thyroid extract.

*The use of thyroid extract.* It is well known that the rays, applied to the thyroid gland, tend to diminish its secretion, and in time lead to atrophy of the gland. In the application of the rays for recurrences and metastases from carcinoma of the breast, much of the radiation reaches the thyroid gland, and therefore, theoretically, would tend to diminish the secretion. This fact, together with the fact that at the time of life when carcinoma is most common the thyroid secretions naturally tend to diminish, leads me to believe that the administration of thyroid extract is distinctly indicated. During the past two years I have used thyroid extract in one hundred and fifty cases, and I am led to believe that it has improved my results to a considerable extent. I believe that with increased knowledge, the administration of the extract can be regulated so far as to accomplish even more.

I usually begin with the administration of one-half a grain of thyroid extract, three times a day, after meals. This is increased every four days one-half a grain in the daily dose, until the patient is taking one and a half grains three times a day. I have not at any time given over two grains, three times a day.

In only a few patients have I obtained any symptoms that I think can be referred to the administration of the thyroid extract. These symptoms consisted of an increased pulse rate, a sensation of faintness and weakness, and at times a slight headache. These symptoms disappeared after the interruption of the thyroid extract for a week.

CASE 1. Mrs. C., age 61, was referred to me by Dr. Ernest Laplace on October 29, 1903. She had been operated upon by Dr. Laplace for carcinoma of the left breast three years previously. During a year recurrences with pain had been developed in the operative wound, and in the axilla. Firmly adherent nodules were found, varying from one-half to one inch in diameter, and extending into the axilla. Small, hard, adherent glands were also found in the supraclavicular region. Active treatment was given for three months, at the end of which time a mild dermatitis developed, but the nodules had disappeared, and the patient was free from symptoms. Against my advice she took a trip across the continent, returning at the end of three months with an increased development of the disease, and presenting at this time large, adherent masses in the supraclavicular region, resulting in paralysis of the left arm. Under treatment during three months, all evidence of the disease again disappeared. The patient even recovered the use of her left arm. She again interrupted treatment for a three months' vacation, at the end of which time she returned suffering from excruciating pain in the left axilla and arm, with palsy and atrophy of the muscles; also enlargement of the supraclavicular glands. X-ray examination showed enlarged mediastinal

[1] Read before the Seventeenth International Medical Congress, London, August 6 to 12, 1913.

glands. She was placed under active treatment, which was continued for nine months, at the end of which time she seemed to be well excepting for the atrophy and palsy of the left arm, from which she never recovered. After this she was seen at intervals during the following five years, at the end of which time she died from intestinal disturbances, which may or may not have been a part of the primary disease. No autopsy was permitted, but the patient's symptoms were chiefly diarrhœa and exhaustion.

In this case we had to do with the extensive recurrences and metastases which extended even into the mediastinum; yet through the action of the rays this patient was kept alive, and fairly comfortable, during a period of seven years, during which time she made several trips across the continent, traveled extensively through Europe, and was able to carry on her usual duties. The palpable evidence of the disease had disappeared. The palsy and atrophy of the muscles, following the neuritis, caused by the pressure of the glands, did not disappear, excepting after the first attack.

CASE 2. Mrs. S., age 45, was referred to me by Dr. Chas. Johnson of Charleston, South Carolina, October 9, 1902. She had had her left breast amputated two years previously. During six months she had been suffering from a recurrence in the scar, one and a half inches in diameter, firmly adherent, tender and painful. Active treatment was continued during two years, during which a mild dermatitis had been produced several times, but which resulted in a complete disappearance of all evidence of the disease. Treatment was then interrupted, and two years later the patient returned with a secondary degeneration of the skin, resulting from the radio-dermatitis. This area then covered about one inch in diameter. It was excised and examined microscopically, but not found malignant. She is still living, and apparently well to-day, eleven years after beginning the treatment for the recurrence.

In this case the treatment of the röntgen rays, given even during the early days when technique was poorly developed, resulted in an apparent cure, which has lasted during a period of approximately eleven years. The secondary degeneration, resulting from a dermatitis, could probably be avoided by present day technique.

CASE 3. Mrs. C., age 42, was referred for treatment by Dr. Wm. L. Rodman, July 22, 1903. She had been operated upon for carcinoma of the breast six months previously, and was then suffering from recurrence in the wound, an adherent nodular mass in the axilla, with severe pains radiating down the arm. She was treated actively twice a week, for ten months, at the end of which time she seemed to be well, and was still well April 1, 1909, when last heard from. She received in all fifty-five treatments. All evidence of the disease disappeared, and the patient seemed quite well.

CASE 4. Mrs. J. F., age 46, was referred for treatment on May 11, 1911, by Dr. R. D. Newton. She had had a complete operation for advanced carcinoma of the left breast in September, 1910. She had noticed nodules forming in the operative field, beginning about three months before coming to me. At her first visit I found an extensive, nodular infiltration of the entire operative field; hard, adherent glands in the supraclavicular region; swelling of the left arm; a general infiltration of the subcutaneous tissue below the axilla, and some infiltration of the opposite breast. It was looked upon by myself and everyone as a hopeless case, but a most remarkable result followed. At the end of 48 hours, following two full dose treatments, the diseased tissue had been reduced to one-half. This reduction affected even areas that had not been directly exposed to the rays. Under active daily treatment, the disease progressively disappeared, until no evidence of the disease could be detected. She was shown before the surgeons at the Clinical Congress in November, 1911, at which time, to all outward appearances, she seemed to be well.

Apparently the rough handling that she got over the tissues at this time seemed to excite the disease, for following this demonstration the disease began to grow, spread rapidly, and was very little influenced by treatment. This case is very instructive. The fact that extensive subcutaneous infiltration of metastatic carcinoma should show a reduction to one-half at the end of 48 hours from the time treatment was begun would suggest that in some way in this case antibodies were produced which assisted in the removal of the disease, for diseased tissue was affected even in areas that were not directly treated.

The fact that the disease continued to disappear until none of it could be palpated and the patient seemed to be physically well, would seem to indicate that this change was brought about through the action of the rays, and careful observation of such results may point the way to a more ideal treatment of the disease. It teaches us that even hopeless cases will sometimes respond to treatment. It teaches also that rough palpation should be avoided in the areas previously involved.

CASE 5. A similar case, and the most extensive carcinoma that I have ever seen, was that in a woman, age 48, who was referred to me by Dr. Radcliffe Cheston, December 28, 1911. She had been operated upon for carcinoma of the left breast in September, 1910. When I first saw her, she was bedfast, and had an open ulcer the size of her hand over the operative field, with general infiltration of the subcutaneous tissue, extending into the left axilla, up to the clavicles, across the sternum, and involving the opposite breast, which was one large mass of carcinoma, extending up to the clavicle on the right side, and into the axilla of the right side. Nodules extended down below the costal border on both sides. The patient suffered from severe pain and weakness.

Under active treatment during five months, the ulcer healed, all the infiltration of the subcutaneous tissue disappeared, and the right breast was reduced to about one-third of its original size. This, however, was still firm and fibrous, though not adherent. At this time she was able to walk, though not strong, and was planning to go away for the summer. Apparently through some indiscretion in diet, she developed a diarrhœa, resulting in a gaseous accumulation in the intestines; embarrassed respiration, which was followed by hypostatic pneumonia, from which she died on July 31, 1912; or, approximately seven months after beginning treatment, and two months after the outward evidence of the disease had disappeared.

The disappearance of so extensive a disease under the influence of the rays certainly proved a most decided effect of the treatment. Whether

the visceral symptoms were secondary to the original disease, or whether it was an intercurrent infection, no one will ever be able to say positively. No autopsy was permitted. X-ray examination shortly before her death showed consolidation of the bases of the lungs, with new involvement of the upper portion, and new involvement of the mediastinum. This fact would seem to indicate that her death was not due to visceral metastases. It would seem to indicate that if the disease had been treated a year earlier, or immediately after the operation, we would surely have had a right to expect recovery.

CASE 6. This case is almost identical with the previous case, and serves as an illustration of another very extensive carcinoma *en cuirasse*. This patient, Mrs. B., age 40, was referred by Dr. Isaac Leopold, June 13, 1911. Five years previously she had her left breast amputated by Dr. Edward Martin, and two years previously he removed a growth from beneath the right breast. During six months an extensive recurrence had developed, and when she was brought for treatment, the entire left side of the chest, extending back to the posterior axillary line, and extending across the sternum, involving the entire right breast, and extending into the right axilla, was one carcinomatous infiltration, with outlying nodules, and with small shining nodules in the surface of the skin. Daily X-ray treatments were given, and the disease was attacked from all sides. In six months the disease had disappeared from the anterior surface of the chest, but there was an extension through the lymphatics of the subcutaneous tissues on the left side, extending to the spinal column, covering an area about five inches broad. Treatment was begun on this on December 12, 1911, and in six weeks the disease had disappeared from the back. She was then kept under treatment at intervals until March 19, 1913, when treatment was interrupted for a time, and she developed a pleuritic effusion on the left side. This filled the chest, and was later withdrawn, and the pleural cavity infiltrated with oxygen. A röntgen examination was then made, and no evidence of mediastinal or pulmonary metastasis could be found. This fluid has recurred several times in the chest, and we are uncertain as to whether this is due to a malignant infiltration, or not.

One would think that the röntgen examination would have shown some evidence of the disease, if this could have been the cause. We are at least certain that a very extensive carcinomatous infiltration of the subcutaneous tissues, involving the greater portion of the chest, completely disappeared, making the patient comfortable, and enabling her to live at least two years longer than she would have otherwise. The outcome at present cannot be predicted.

CASE 7. Mrs. B., age 56, referred by Dr. John B. Deaver, December 1, 1910, had an operation for removal of the breast three months previously. At the time of beginning treatment there was distinct evidence of recurrence in the axilla and supraclavicular region. Under active treatment by the rays, there was some reduction in the disease, but on April 11th, Dr. Deaver still found deep axillary and infraclavicular disease. This was associated with swelling of the arm, and pain. Treatment was continued until September 1, 1911, when all evidence of the disease had disappeared. She then developed an exfoliated dermatitis, involving both the skin and mucous membrane over the entire body. Since then she has remained perfectly well, the time now being two years and nine months since beginning treatment for deep recurrence. Her attending physician believed that she also had mediastinal involvement at the beginning of treatment. To-day she seems to be perfectly well.

CASE 8. Miss H., aged 45 years, referred to me by Dr. William Martin, October 5, 1911. She had noticed a tumor in her right breast several months, which she thought followed a bruise (walking into a rail). A sister had died from a carcinoma of the uterus about a year previously. Examination showed a tumor in the right breast about half the size of a hen's egg, a small palpable gland in the axilla, and a barely palpable gland in the right supraclavicular region. In the upper and outer quadrant of the left breast a tumor about the size of a pigeon's egg was palpable. She had signs of osteo-arthritis in the cervical and upper dorsal spine. She had a polypus on the cervix of the uterus.

There was some doubt in the diagnosis, therefore I referred her to Dr. M. P. Warmuth, who amputated the right breast, cleared the axilla, and removed the small gland from the right supraclavicular region and a polypus from the uterus. Microscopical examination by Dr. Henry S. Wieder showed distinct scirrhous carcinoma.

Within two weeks after the operation, she had the excruciating pains of carcinoma, and within a month the entire operative area was indurated and showed distinct recurrence in the wound, the axilla, and the supraclavicular region, recognized by Dr. Warmuth and myself. At the same time the tumor in the left breast increased in size to that of a fist; and with enlarged glands in the axilla.

Very active daily treatment was given to the recurrence on the right side until a slight dermatitis appeared, then treatment was given to the left breast — which was clearly inoperable, under these conditions — and each side was treated in turn until all evidence of the recurrence had disappeared from the right side, and until the left inoperative breast had become soft and all parts freely movable. On the two sides she had had in all one hundred and eighty-six applications of the rays. At the end of nine months no distinct evidence of the disease could be recognized. She had returned to her usual affairs of life, was taking gymnastic exercises, and had been quite well since. During the early part of January, 1913, she bruised the left breast; the skin which had been damaged by the rays became eroded and painful. I then referred her to Dr. Warmuth for excision of the breast. The axilla was not opened, because we believed the rays had sealed this glandular area. Pathological study by Dr. Eugene Case, confirmed by Dr. Joseph McFarland, showed no evidence of malignant disease anywhere, but showed pigmentation and necrosis of the skin and chronic diffuse fibrosis of the breast.

The results in this patient seem to be most striking and indisputable. The carcinoma of the right breast, with metastasis, was thoroughly removed, and upon microscopical examination proved to be an undoubted case of malignant disease. The disease recurred at once, and no one doubted the recurrence. All this recurrence disappeared under the action of the rays. The disease in the left breast increased rapidly after amputation of the right. No one doubted its

malignant character. Under the action of the rays, the clinical signs of the disease disappeared, and subsequent amputation of the breast showed neither microscopic nor macroscopic carcinoma.

CASE 9. Mrs. W., age 35, referred by Dr. E. B. Rogers. The patient had had her right breast amputated on account of carcinoma in May, 1908. At the time of beginning X-ray treatment there was induration of the tissues in the upper portion of the scar, and extending into the axilla, with enlarged, hard, adherent glands in the right supraclavicular region.

The patient was treated three times a week, and at the end of six months all evidence of recurrence and metastasis had disappeared. She remained well until April 27, 1911, when a tumor developed in the left breast. Both sides were then treated actively again, and she has remained well to date, which is nearly five years since beginning treatment for metastasis and recurrence.

CASE 10. Mrs. E., age 50, was referred to me by Dr. John B. Deaver on December 31, 1908. She had been operated upon for carcinoma of the left breast on November 17, 1908. She was given post-operative treatment, and remained well until May 24, 1909, when a small nodule developed in the upper portion of the scar. Dr. Deaver, who examined this, believed it to be malignant, and advised excision. Active treatment was applied by the rays to this nodule, and when she was taken to the hospital three weeks later Dr. Deaver could not find the nodule, and refused to operate. She has remained well to date, which is nearly five years.

CASE 11. Miss H., age 50, was referred by Dr. John B. Deaver, November 2, 1912. She had been operated upon for carcinoma of the breast by Dr. Deaver in June, 1911. She noticed a recurrence in September, 1912. When first seen by me there was a tumor the size of half a hen's egg, at the middle of the scar, firmly adherent to the ribs, and Dr. Deaver considered her inoperable. Under X-ray treatment this has completely disappeared; she has regained perfect health, and so far as we can tell she is well.

CASE 12. Mrs. D., age 65, was referred for treatment by Dr. J. W. Schaffer. She had had an attempted removal of carcinoma by a caustic. When this was unsuccessful she had radium applied, having 48 hours' exposure to radium in all. Nothing was done for a year, during which time the recurrence developed in the breast, in the axilla fold, and in the supraclavicular region. When applying for treatment by X-ray she had a mass in the left axilla one-half the size of her hand, firmly adherent, hard and painful. Under X-ray treatment this has completely disappeared, and to all outward appearances she is well.

CASE 13. Mrs. E., aged 49 years, was referred to me by the Rev. Russell H. Conwell, July 27, 1908. She had been operated upon for carcinoma of the left breast five years before, at one of the leading hospitals. At that time the tumor was said to be the size of a walnut, and was excised. Recurrence developed within two years. When she came to me the tumor tissue involved the entire mammary region, with axillary and supraclavicular involvement. The mass was so large that it left the impression on my mind of an extensive primary growth. It was a hard, painful, adherent nodular mass, ulcerated at several places. It was so far advanced that I wrote to Doctor Conwell that I believed nothing would be accomplished. In the absence of any other hope, I treated her with the rays.

In a month the mass of tumor tissue was reduced to half, and the ulcers were healing. In two months it was reduced to a third, the ulcers were healed, and in three months no tumor could be palpated. There remained, however, a puckered central scarlike mass of tissue, about one-half inch in diameter, which was freely movable, and which was not painful. I believed there was no malignant tissue present, but I feared that later this mass would undergo degeneration and accordingly referred her to Dr. W. Wayne Babcock for operation, January 18, 1909.

I believed that only a local excision was necessary, but Dr. Babcock did a complete operation. Pathological examination of the specimen by Dr. Duncan showed some evidence of malignant disease. She was sent back to me in six weeks, when both Dr. Babcock and I felt a hard nodule in the supraclavicular region, about the size of a pea. This was reduced under treatment to one-eighth of an inch, and has since remained stationary. About a year ago a hard nodule one-half inch in diameter was discovered in the right axilla. This has decreased in size, but has never disappeared. At first the patient was treated daily, then less often, and during the past three years she has been seen once a month for the purpose of keeping her under observation. In the four and a half years she has had seventy-six applications of the rays. The left mammary area shows marked telangiectases.

This woman was clearly inoperable when referred to me for treatment because of the extent of the disease, and seemed hopeless even in my estimation. The disease had practically disappeared in three months. The puckered scar was then removed. Her general health improved immediately, and during three and one-half years she has felt and looked perfectly well. The fact that the disease was recurrent and metastatic makes the result all the more convincing.

CASE 14. Mrs. T., aged 38 years, referred to me by Dr. Samuel Johnston and Dr. Ernest Laplace, January 8, 1909. Tumors had been noticed in her breasts eight years previously. They gradually increased in size and secondary nodules developed under the anterior axillary fold.

At the beginning of treatment there was a mass, one and a half inches in diameter, in the lower outer quadrant of the left breast, and one two and a half inches in diameter in the upper and outer quadrant, with a small nodule under the anterior axillary fold. Both were hard, nodular and adherent. There was a similar tumor in the right breast, one and a half inches in diameter, in the lower inner quadrant. She was considered inoperable because of the extent of the disease. She was treated three times a week at first. During the past three years she had been seen once or twice a month, partially for treatment and partially for observation. In all she had been treated one hundred and fourteen times. The tumors were reduced to a fibrous mass about one-half inch in diameter, freely movable, and not tender. Her general health had at no time been interfered with, and in general appearance she looked perfectly well.

The treatment was carried to the point of producing an erythema, several times, and as a result the skin was atrophic and showed a number of telangiectases. This patient was living and symptomatically well, over four years after she was referred with carcinoma of both breasts with metastasis. She had suffered no inconvenience except that of coming for treatment.

CASE 15. Miss G., aged 37 years, was referred to me by Dr. John B. Deaver, July 14, 1911. A carcinoma had been growing in the right breast over three years. In September, 1910, she was taken to Dr. Deaver by Dr. George Miller, for operation, but at that time the disease had advanced so far that Dr. Deaver considered operation inadvisable. Ten months later, when the carcinoma had become an ulcerating mass, she was taken to Dr.

Deaver again, at which time he referred her to me. She then had an ulcerating tumor about four inches in diameter, adherent to skin and ribs, with several small metastatic nodules about the tumor. There were enlarged glands in the axilla and the supraclavicular region. She suffered from severe pains.

Under treatment the ulcer gradually healed, the tumor tissue disappeared, and even the scar tissue became movable upon the chest wall. There was no definite evidence of disease in this area for about a year. (In these patients, it is difficult to decide just when the disease has all disappeared.)

About May 1, 1912, a tumor developed in the upper and outer quadrant of the left breast. She was sent to Dr. Deaver, May 18, 1912, to have him see the result in the right breast, and to confirm the diagnosis of carcinoma in the left breast. The tumor in the left breast had nearly disappeared, and in its place was some increased firmness, which, I believed, was due to fibrous tissue. She had two hundred and six applications of the rays in all, counting both sides.

During all this treatment she improved in general health; pains were relieved; and she increased in weight and strength. There were, of course, some atrophy and telangiectases of the skin on the right side. After two or three years, this is likely to degenerate and become necrotic. If so, and there is no carcinoma present, excision and skin grafting should be done.[1]

This patient was clearly inoperable because of the extent of the disease. The disappearance of this advanced disease in the right breast under the action of the rays gave encouragement toward further effort, when signs of carcinoma developed in the opposite breast nearly a year later. The relief of the symptoms in the second breast shows that good results may at times be obtained even in a patient with a pronouced constitutional tendency.

### TECHNIQUE

The technique of the application of the röntgen rays in my experience in the treatment of the metastatic and recurrent carcinoma, upon which this paper is based, has, of course, passed through the various stages of the development of röntgen therapeutic technique, from the very small and superficial doses, often repeated and unfiltered, to the present larger doses of filtered rays, applied less frequently, but more thoroughly, and from as many directions as possible. Therefore, as would be expected, good results are more frequent at present than formerly.

1. A thorough examination of the patient is necessary to determine the extent of the disease. This will require careful inspection and palpation of the entire chest and glandular regions, and generally a röntgen examination of the chest.

2. Having determined the extent of the disease, the skin is divided into as many areas as possible, through which the rays may be directed to the deepest area of disease. This division should not be so much subdivided as to waste energy. Generally I apply the rays from four or five different directions, the anterior axillary and mammary, the posterior axillary and scapular, the axillary and the supraclavicular. In this way the deeper portions of the disease, especially the mediastinal glands, are reached by each application. The areas of skin not directly exposed should be protected by layers of lead foil, or some opaque material.

3. The exposed skin should be protected by filters. For this I originally depended upon leather, one-eighth of an inch thick (first recommended by me before the American Röntgen Ray Society, September, 1905), which I found gave considerable protection. To this I now add from one to four millimeters of aluminum. These filters are placed about one-half inch from the surface of the tube, and between the tube and the patient. In this way the filters never touch the patient and are never soiled. In my apparatus they occupy the top of the diaphragm of the protected tube holder.

4. The quality of rays should be sufficiently penetrating to carry a good proportion to the deepest part of the disease, and should be from 6 to 8 as measured by the Benoist scale. Great difficulty is usually encountered in keeping the rays emitted by the tube of a uniform quality. For this, I have found the water-cooled tubes most efficient, when kept uniformly cooled by a constant stream of water flowing through the cooling chamber.

5. The dose should be carefully measured and the erythema limit should not be exceeded. For this purpose the Sabourand pastilles have served me best. The treatment should be carried to this limit as quickly as possible in each area. After the erythema dose has been gone over, any particular area treatment should not be repeated at this point for at least two weeks. The interval during which one should wait will have to be increased with each repetition.

### CONCLUSIONS

I have selected for study the above fifteen cases because they were rather striking examples of what can be at times accomplished, and it would seem to me that we can draw the following conclusions:

1. That the application of the röntgen rays will at times cause a disappearance of both small and extensive areas of both recurrent and metastatic carcinoma.

[1] Cases 8, 13, 14, and 15 have been previously referred to in a report upon "Inoperable Carcinoma of the Breast." N. Y. M. J., 1913, April 26.

2. That the disease can at times be made to disappear when it covers the greater portion of the chest.

3. In at least one case there seemed to be produced some constitutional condition which led to the rapid disappearance of carcinomatous tissue that had not even been exposed to the rays.

4. The additional administration of thyroid extract in small doses seems to aid materially in the cure of the disease.

5. The disease should be treated as actively and with as large doses as circumstances will permit, using every possible means for the protection of the skin.

6. Since the above cases prove that extensive recurrent malignant disease can be made to disappear, the best time to treat with the rays is immediately after operation when least disease is present. This post-operative treatment should be thorough and given with the same care that would be used with palpable disease.

---

# HÆMOSTASIS IN CRANIAL SURGERY

By L. H. LANDON, M. D., Philadelphia
Assistant Surgeon to University Hospital

No single factor in the technique of neurological surgery, particularly that involved in exposing the brain, is more important than the proper and efficient control of hæmorrhage. The extreme and peculiarly constituted vascularity of the scalp, the presence of the emissary venous sinuses varying in their size and position, the large vascular lacunæ in the diploë, the vessels entering the skull through their bony canals for the supply of internal structures, and lastly the delicate and intricate network of vessels incorporated in the meninges, all present varying and trying problems to the surgeon and are a source of constant danger to the patient.

Unless the armamentarium of the surgeon contains the proper mechanical agents and unless he has the experience and judgment to cope with this troublesome phase, the often alarmingly profuse hæmorrhage will be a constant source of annoyance during the operation and a menace to the life of the patient, for whom the prognosis would otherwise be good.

It is the purpose of this paper to review those measures which have been found most efficacious by those having the largest experience in cranial work and to describe the tourniquet which I devised and had made for the use of Dr. Charles H. Frazier, in his service at the University Hospital.

The exceedingly free blood supply of the scalp renders control of hæmorrhage much more difficult than elsewhere on the body surface. This is due not only to their number and free anastomosis but to the peculiar anatomical arrangement of the blood-vessels in the tissues. Five large trunks enter the scalp on each side, the frontal and supra-orbital in front, the superficial temporal and posterior auricular laterally, while posteriorly, the large occipital artery approaches between the borders of the sternomastoid and trapezius muscles. These vessels break up into an enormous number of branches which anastomose with one another and with their fellows of the opposite side in a remarkable manner.

The venous return is even more complicated, as the free communication between the veins and the diploic circulation renders hæmorrhage from this source quite as profuse and difficult to control as that from the arterial side.

The skin of the scalp is one of the densest in the body. In its deeper layers and in the tough unyielding fascia which binds it to the aponeurotic layer beneath, is the major portion of the blood-vessels. The tough surrounding tissue not only prevents contraction and retraction of their cut ends, but makes grasping the severed vessels with ordinary hæmostats and ligation usually impossible.

The vascularity of the other layers of the scalp is very meager and presents no difficulty in its control.

*Control of the superficial hæmorrhage:* This is a much simpler matter in those operations on the vault than in those at or near the base of the skull. Among the latter may be mentioned operations for exposure of the gasserian ganglion, subtemporal decompression, the MacArthur-Frazier route to the pituitary, and exposure of the cerebellum.

The posture of the patient has a distinct effect upon the freedom of the hæmorrhage. The semi-sitting posture at an angle from 45° to 60° is not

only a definite controlling factor in the bleeding but offers the most advantageous position for the convenience of the surgeon in exposing the deeper structures. This position can always be obtained except in those procedures on the posterior fossa where the patient must be placed face downward. Here a specially constructed table which will allow elevation of the head without displacement of the field of operation to an inconvenient height is of advantage. Of course, with the patients in these positions, a constant record of blood pressure is essential. If this falls to a dangerous level, the more nearly horizontal position is immediately assumed. It is always interesting to note the almost immediate effect this change in position has upon the venous bleeding from the wound.

The state of and the nicety in the administration of the anæsthetic will also greatly aid or delay the surgeon in the control of bleeding. A half-anæsthetized, cyanotic patient or one whose respiratory passages are constantly filled with mucus is always a menace; the resulting intense congestion of the veins often causing furious hæmorrhage. The use of the intratracheal or the intrapharyngeal insufflation methods of anæsthesia has greatly facilitated the nicety and the uniformity with which the patient is kept under the influence of ether.

The most convenient means of controlling scalp hæmorrhage in those operations where it is applicable, i.e., those on the vault, not at or near the base, is some form of encircling tourniquet. There have been many devices for this purpose: rubber tubing, a modified Petit's tourniquet, and pneumatic tube incased in metal jackets on the outside, by the inflation of which the desired pressure could be obtained. They are, however, all more or less cumbersome, difficult to apply, maintain in position and remove, while the presence of rubber in their construction renders them very short-lived when frequently sterilized as is necessary.

To overcome these disadvantages and to obtain an instrument consisting entirely of metal, our tourniquet was devised. It consists of a thin flexible spring-steel encircling band, 14 mm. wide and about the thickness of the ordinary steel tape measure. It is broken fore and aft. Posteriorly there is a sliding joint controlled by a strong coiled spring. This spring in no wise measures the amount of pressure exerted by the band, as the friction between the band and the gauze covering the head prevents slipping of the tourniquet and hence strain upon the spring during any safe constriction. Its action, then, is simply that of a safety valve. Anteriorly is the self-locking lever ratchet by which the band is tightened to any desired pressure. Laterally there are two sliding adjustable auxiliary springs which lie over the temporal fossæ for added pressure over and control of the temporal arteries. There is also a detachable and adjustable steel band which passes from the midline in front along the line of the longitudinal sinus to a like point in the rear and prevents displacement of the tourniquet downward. When the instrument is properly applied, however, with adequate pressure, the use of this strap will seldom be necessary.

To apply the tourniquet, the head is covered with three or four layers of sterile dressing gauze, the band, previously sterilized, is slipped over the head until it rests on a line passing just above the ears from the glabella in front to just below the inion behind. The temporal springs are now slid to their proper positions and the slack taken up through the sliding joint in front. The hook of the lever is now inserted into one of the catches, three or four holes from the midline, and the lever snapped shut, which draws the band tight. After a little experience, one can accurately estimate the amount of constriction necessary for hæmostasis by the force required to shut the lever.

When it is desired to remove the tourniquet the lever is raised, the band springs open and it is lifted from the head. The instrument being entirely of metal is practically indestructible, can always be sterile and may be readjusted, tightened or loosened to any desired pressure or removed at any time during the operation with ease and without fear of contamination. Caution should be taken that this or any other tourniquet is applied with sufficient pressure to occlude all the arteries, else it will be worse than useless by shutting off the venous return only, causing intense congestion and greatly increasing the hæmorrhage.

There is at least one condition which also renders the use of a tourniquet disadvantageous. In some cases of large cortical cerebral tumors, the normal communications between the internal veins and sinuses of the skull and those in the scalp is so greatly exaggerated that occlusion of the latter only increases the flow of blood from the scalp wound. This is particularly liable to happen when the tumor is of the very vascular and malignant type. Here recourse for control of hæmorrhage must be had to digital pressure by an assistant to either side of the wound until the bleeding points may be caught, or better, the edges of the scalp grasped by some one of the forms of scalp clamps. Of these clamps there are many, but the Allis hæmostat serves every pur-

Fig. 1. Showing sitting posture; anterior view of tourniquet applied, showing the self-locking catch in front.

Fig. 2. Illustration showing proper position of patient; lateral view of tourniquet applied, adjustable headrest, and intrapharyngeal method of anæsthesia. Note the additional pressure over the temporal arteries.

pose, is quickly and easily applied, and there is not the danger of injurious traumatism to the tissues as with some of the other models. In some of these cases the loss of blood may be so great, even before the dura is exposed, as to necessitate postponement of the operation to a second sitting. In some the question of ligation of one or even both carotid arteries may be considered. This is not often necessary, however, and when done should be by means of a temporary ligature or metal clamp, which should be removed or partly released upon the development of any signs of deficient cortical circulation sufficient to cause motor or sensory disturbances.

It is seldom that a ligature need be applied to the scalp wound: the tourniquet or the hæmostats are left on until the end of the operation, are then removed and the wound closed with deep interrupted sutures of silkworm gut; the sutures passing beneath each bleeding point, when tied, will usually sufficiently control all bleeding.

There are many other methods of controlling scalp hæmorrhage, among which may be mentioned the hæmostatic safety pins of Vorschutz, Kredel's hæmostatic sutures, the clamps of Hudson and Tate, and deep backstitch running sutures circumventing the wound. All are of use in those procedures not permitting the use of the tourniquet, the backstitch especially in suboccipital craniectomies where it is run along the line of the superior occipital ridge from one mastoid process to the other. The suture is carried down to the bone, each stitch overlapping the other about half, and drawn sufficiently tight to occlude the vessels.

*Control of the deeper hæmorrhage.* The superficial bleeding having been controlled, the surgeon is next met with hæmorrhage from the bone. This occurs from several sources, the emissary veins and sinuses which may be greatly increased in number and size, the diploic veins, or from the middle meningeal artery when the field of operation includes the sphenoparietal region. Bleeding from the emissary veins is seldom difficult to control, often ceases spontaneously, or their orifices are plugged with Horsley's wax. Certain of these channels should, however, be borne in mind, when operating in the occipital region. There are usually two or three large foramina, chief of which is the mastoid, lying one and a half to three centimeters inside the mastoid process, and which communicate internally with the lateral and sigmoid sinuses and externally with the occipital

veins. There are also several nearer the midline which spring from the occipital sinus. Hæmorrhage from these sources may be shockingly profuse in a very short time, sufficient to endanger the life of the patient if not controlled, but this is usually easily done with wax, although plugging with wood or bone pegs may be necessary.

Bleeding from the diploë is usually of no moment; the use of the Cryer spiral osteotome for cutting out the osteoplastic flap aids greatly in its control both by the heat of friction and the plugging of the sinuses with the fine bone dust.

In some procedures where the dura has to be raised from the base of the skull for exposure of deeper structures one may encounter some hæmorrhage from the torn dural vessels entering the inner aspect of the bone. As a rule, however, this is very slight, although in the older operation of gasserectomy it was often severe when the ganglion was raised. This danger and that of injuring the cavernous sinus has been practically eliminated by the Spiller-Frazier method of avulsion of the sensory root. In this operation, the only bleeding of moment comes from the middle meningeal. This artery is deliberately cut as it enters the skull through the foramen spinosum and the foramen immediately occluded with Horsley's wax. This is usually sufficient; but if not, its orifice may be plugged with a wood peg conveniently whittled from a swab stick.

Bleeding from the external surface of the dura itself is seldom serious in quantity but may be very persistent. The larger vessels are ligated with the finest silk, the ligature carried around the bleeding vessel on a fine curved needle. Care should be taken while doing this not to wound any of the underlying pial vessels. Other persistent points of bleeding in the dura are stopped by the application of bits of gauze or cotton wrung out of boiling saline solution or by the application to the point of a bit of muscle tissue, easily snipped from some of the exposed muscle. This latter method, whose action is physiological, was first used by Sir Victor Horsley for this purpose and is most satisfactory. The muscular graft is not removed but closed in the wound.

It is seldom necessary to encroach upon the larger sinuses of the dura. As a matter of caution, however, mention should be made of the deviation of the superior longitudinal sinus toward the right as it passes backward. Posteriorly, therefore, operations can be carried farther toward the midline on the left side than on the right. In the parietal regions also it should be borne in mind that the pacchionian bodies are not only more numerous but are farther from the midline and are surrounded by large vascular lacunæ offshoots of the longitudinal sinus. If these should be wounded accidentally, the application of muscle grafts and inaction — unless the hæmorrhage be dangerous—is the best policy, the bleeding often ceasing spontaneously if the dura is not pressed away from the bone. If more vigorous means are indicated the overlying bone must be rongeured away and the sinus ligated on either side of the rent with fine silk.

The greatest care should be taken to avoid hæmorrhage from the pial vessels. The dura is opened along a grooved director and the manipulations of the cortex must be most delicate. If deeper exploration of the brain be indicated, the overlying pial vessels are ligated on either side of the proposed wound. For this the very finest silk mounted on a fine curved needle is employed. Serious hæmorrhage from this source is usually the result of bungling or harshness. It may, however, be unavoidable and very profuse in those cases of cortical tumors of a malignant type which are on or near the surface. Heat by means of the hot saline solution in cotton and also muscular tissue is of use here as in the dural bleeding.

Notwithstanding all the care and precautions that may be taken, hæmostasis at the end of any cranial operation is seldom perfect and it often becomes necessary to institute drainage for the first few hours following the operation. For this purpose, strips of rubber tissue are the best. In more profuse bleeding, a small rubber tube may be used, or strips of gauze. When the latter is used, it should be wrung out of sterile liquid petrolatum which prevents adherence of the gauze to the tissues and recurrence of the bleeding when the drainage is removed. Usually the drain should be brought out through a counter opening at the lowest angle of the wound; it should never be left in over twenty-four hours and is preferably removed in from fifteen to eighteen, the opening then covered with a wisp of cotton moistened with 5 per cent iodine solution. When the condition of the patients warrant, they are always placed in bed in the sitting posture as soon as they are out of ether. This greatly assists in the prevention of or the continuance of hæmorrhage.

For knowledge in the practical application and use of these methods of hæmostasis, I am greatly indebted to Dr. Charles H. Frazier, whom it has been my privilege to assist in a considerable number of these cases.

# FRACTURE OF THE LOWER ENDS OF THE TIBIA AND FIBULA[1]

By A. R. COLVIN, M. D., St. Paul, Minnesota

My excuse for bringing so familiar a subject before you is that I am convinced that the classifying of nearly all of these injuries as Pott's fractures has led to confusion in treatment. The surgeons of preradiographic days were undoubtedly possessed of a high order of clinical observation, but the more one sees of radiographs of injuries in this region, the more one speculates as to the amount of error there must have been in the interpretation of clinical pictures, by even expert clinicians.

In Treves' Surgery, for instance, it is stated that Pott's fracture is the most frequent of all fractures at the lower end of the leg.

The radiographic study of fractures, while widening our possibilities of clinical interpretation, also convinces us of the impossibility of arriving at clinical conclusions under certain conditions, unless such a conclusion should be that we cannot know.

The fact that the best clinical powers are bound to err furnishes an explanation why the fractures under discussion, being so freely interpreted as Pott's fracture and treated accordingly, should inevitably lead to bad results.

That the end-results of treatment are not satisfactory in a large number of cases is evident, when one reads a report of any considerable number of fractures.

Malineus[2] says that the result is far from satisfactory in fully one-third of the cases.

The failure to treat Pott's fracture by the approved method is as serious an error as it is to treat a variety of lesions by this method.

Pott's description of the fracture which bears his name was a fracture of the fibula, about three inches above the ankle-joint, combined with a rupture of the internal lateral ligament (Fig. 1).

Dennis' System of Surgery, Treves' System of Surgery, and Agnew's Surgery are the only works in English where I have found the original description adhered to. Nearly all other authors, while agreeing that it is unsafe to lump all these injuries under one heading, nevertheless illustrate with radiographic reproductions, various injuries as Pott's fractures, and then, with few exceptions, emphasize the inversion treatment.

My own observations and perusal of illustrated literature on this subject convinces me that Pott's fracture, in the strict sense, is a rare injury.

Meissner,[3] reporting 211 cases of injury to the lower end of the tibia and fibula, in the Klinik of von Bruns, occurring since the advent of the radiograph, classifies them as follows:

| Fracture of — | No. Cases |
|---|---|
| 1. The external malleolus, or of the fibula above the joint | 51 |
| 2. The internal malleolus | 7 |
| 3. Both malleoli | 100 |
| 4. Supramalleolar | 39 |
| 5. Epiphyseal separation | 11 |
| 6. Tibial articular surface | 3 |
| Total | 211 |

Meissner says that in pronation fractures he frequently saw a tearing, partial or complete, of the internal lateral ligament, with fracture of the external malleolus.

In a series of 60 cases occurring in the City and County Hospital, Saint Paul, in the services of all the attending surgeons, the lesions were as follows:

| | No. Cases |
|---|---|
| 1. Fracture of the external malleolus, or of the fibula above the joint | 16 |
| 2. Fracture of the internal malleolus alone | 4 |
| 3. Fracture of both malleoli | 27 |
| 4. Fracture of internal malleolus, and of the fibula above the joint, combined with backward dislocation of the foot | 3 |
| 5. Fracture of the internal malleolus, and a splitting off of a considerable triangle of bone from the tibia, at the tibia fibular junction | 1 |
| 6. Split fracture of the tibia, at the tibiofibular junction, of minor degree, with no separation (no other fracture) | 1 |
| 7. Comminution of the articular surface of the tibia | 1 |
| 8. Supramalleolar fracture | 6 |
| 9. Fracture of the fibula, and rupture of the internal lateral ligament | 1 |

In the bimalleolar fractures there were two backward dislocations of the foot, one outward dislocation of the foot, one case with splitting off of the anterior margin of the articular process of the tibia, and one of the posterior margin of the same process.

It will thus be seen that in my list of sixty cases, Pott's fracture, in the semi-strict sense, occurred only once. However, if we allow a tearing off of a liberal amount of the internal malleolus to come within the definition of Pott, this did occur in a number of cases.

[2] Deutsche Ztschr. f. Chir., cxx.

[3] Beitr. z. klin. Chir., lxii.

[1] Read before the St. Louis Medical Society, March 29, 1913.

Fig. 1. Pott's fracture diagrammatic.

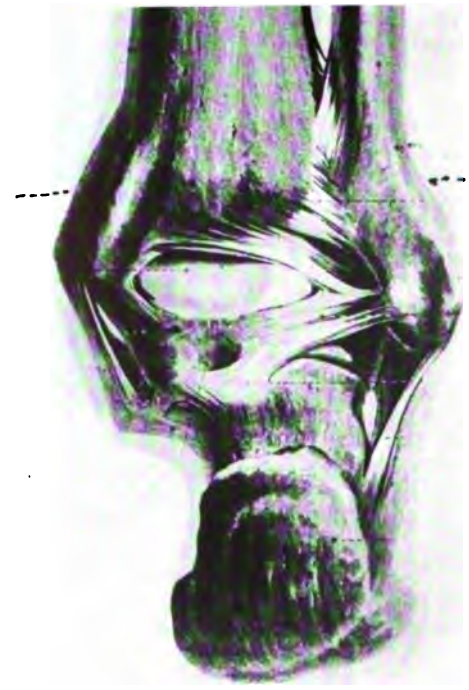


Fig. 2. Anatomy of the ankle joint, showing the foot suspended from the malleoli by the lateral ligaments. It can be readily seen how fracture through the malleoli will make it easy for adduction and abduction to take place at the seat of the fracture.

Displacement of the astragalus, that is, of its upper lateral edge between the fibula and tibia, I did not see in my list of cases, except in a small number of bimalleolar fractures. Fracture of the fibula above the joint, combined with displacement of the upper lateral edge of the astragalus between the fibula and tibia, as a result of a tear fracture, is spoken of as Dupuytren's fracture.

While conscious of the evils that may result from a failure to recognize and reduce the various dislocations of the foot, complicating the injuries

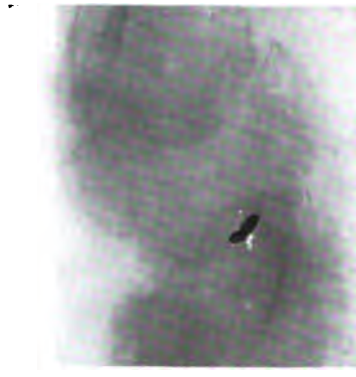


Fig. 3.

Fig. 4.

Fig. 5.

Fig. 3. The deformity caused by treating bimalleolar fracture in the adducted position.

Fig. 4. Fracture of the fibula, at the tibiofibular junction, and tearing of the internal lateral ligament, with displacement of the foot outwards.

Fig. 5. Bimalleolar fracture with the internal malleolus broken in two places. Showing also the eversion or valgun deformity, due to non-correction of the displacement.

under discussion, it is my main purpose to call attention to the necessity for maintained adduction as a retention dressing in the true Pott's fracture, and to the evils resulting from maintained adduction as a retention dressing in other commoner fractures.

It may be well to recall the fact that there is practically no movement in abduction or adduction at the ankle-joint, these movements taking place in the mediotarsal and subastragaloid joints. Adduction is always accompanied by inversion or supination, and abduction by eversion or pronation of the foot. The foot is connected with the malleoli by the powerful lateral ligaments of the ankle-joint (Fig. 2).

In the true Pott's fracture the foot has lost its anchorage to the internal malleolus, either by rupture of the internal lateral ligament, or if we will, the tip of the internal malleolus, and a marked outward displacement of the foot is produced (Figs. 1 and 4).

Inasmuch as the internal lateral or deltoid ligament extends from the internal malleolus to the os calcis and scaphoid bone as well as to the astragalus, marked adduction must be maintained, after reducing the deformity, thus approximating the torn structures on the inner side of the foot during healing.

If we recognize Dupuytren's fracture as a separate lesion, then adduction is indicated here, for the purpose mentioned, and also to hold in apposition the lower tibiofibular separation. If this position is not maintained, we get in Pott's fracture a lengthening of the internal lateral ligament, and when weight bearing is resumed, a resulting pronated foot, which is the weakest position of the foot, and a very disabling one. Even after weight bearing is resumed it is well to have the inner side of the shoe raised, to still throw the tension on the structures at the outer side of the ankle, and relieve the tension of those on the inner side. Marked adduction in this fracture cannot do any harm, because the fracture of the fibula is above the tibiofibular joint, and the upper end of the lower fragment being anchored to the tibia by the interosseous membrane, any inward tilting of the external malleolus is impossible, without tearing the interosseous membrane. Adduction, moreover, will have a tendency

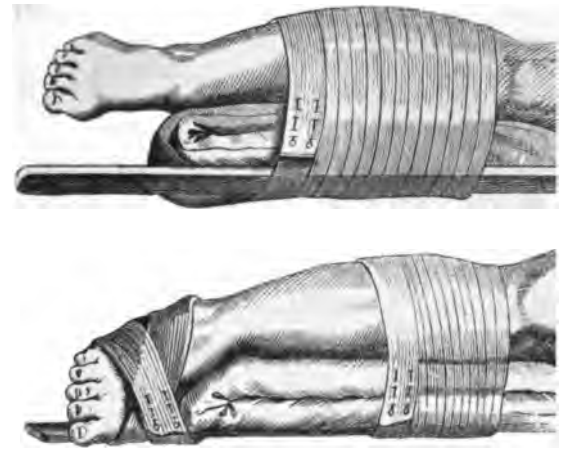


Fig. 6. Dupuytren's splint commonly used for Pott's fracture — the use of this splint in malleolar fractures would surely cause deformity — it is indicated in true Pott's fracture.

Fig. 7.

Fig. 8.

Fig. 9.

Fig. 7. Bimalleolar fracture with outward displacement of the foot and forward subluxation of the foot (see Fig. 8). This foot could be swung in either direction, the movement being through the seat of fracture.

Fig. 8. Showing forward subluxation of the foot (see Fig. 7).

Fig. 9. The fracture shown in Fig. 7, after reduction, abduction or adduction of the foot would correspondingly displace the malleoli.

through the pull on the fibular tip to draw the upper end of the lower fragment outward away from the tibia, whence it has been thrust by the original abducting force.

If the inward displacement of the upper end of the lower fragment is difficult of dislodgment, it might be caught by a pair of tenaculum forceps, and thus drawn outwards.

According to the two lists herein referred to, fracture of both malleoli, at the level of the tibiofibular junction, is by far the the most frequent injury, and it is in this lesion that forcible adduction can do the most harm (Fig. 3).

Moderate adduction of the foot, or such adduction as takes place normally in the joints referred to above, does not have any corrective action upon displaced malleoli. It is only after the normal limit is reached that a continuance of the force will pull, or as it were, rotate the fragments into position. Frequently this can be accomplished more accurately by shoving, rather than rotating.

There should be a distinct understanding in speaking of adduction, in the treatment of these fractures, as to whether it is used as a corrective force, or whether after correction of displacement, adduction within the limits of the joints concerned in this movement is maintained.

The main ligamentous attachments of the foot to the leg being by the two lateral ligaments, in bimalleolar fractures, the foot will be hung as by hinges, at the seat of the breaks, and inversion of any forcible kind will swing the malleolar fragments inward (Figs. 2 and 3). Consequently, accurate replacement of the fragments, and retention with the foot at a right angle without any lateral or medial deviation, is imperative (Figs. 7, 8 and 9).

If the injured member is seen after swelling has taken place, it is very difficult to differentiate the various lesions of this region. With many of them, a dislocation of the foot is possible, and comparatively frequent, and easy of reduction.

With the exception of the types with comminution of the articular surface of the tibia, or a splitting off of the anterior or posterior lip of the articular surface of the bone, reduction is usually easy, and if correct, and if proper retention is maintained, the result is in the majority of cases satisfactory. With comminution of the articular surface, it is impossible to be sure that the fragments have been properly replaced, except by operative measures. Whether this is necessary must be decided in each case by the amount of disability likely to occur. Where the anterior or posterior lips of the tibial articular surface are split off and displaced, reduction of the fragments has been impossible in my hands. The foot, however, can usually be brought to a right angle with the leg, and I have waited for some months before deciding whether it was necessary to remove a piece of bone obstructing dorsal flexion, for in some of them the result has been quite satisfactory without such removal.

SUMMARY

1. The lesions occurring at the lower end of the tibia and fibula are very varied in character, usually requiring the radiograph for differentiation, and as a guide to treatment.

2. Pott's fracture, as he described it, is very rare.

3. The most frequent lesion is a bimalleolar fracture, and the commonest deformity is that of the everted foot.

4. The various lesions are produced by a predominating everting or inverting force.

5. These forces used as corrective measures in either direction may result in the production of a deformity, the opposite to the one caused in the original injury.

6. Adduction or inversion of the foot is not necessary as a retention dressing, except in Pott's fracture, and if used in bimalleolar fractures is very liable to result in deformity.

7. The original inverting or everting force which fractured one or both malleoli may have spent itself before displacement of the malleoli has occurred, and any subsequent force applied in either direction will cause an eversion or inversion deformity.

Honor should be done to Pott by limiting the use of his name to the fracture which he accurately described, and as radiographic observation proves that this is a rare fracture, it is all the more honor to him that he recognized in the preradiographic days this rare lesion.

# AN IMPROVED METHOD OF HÆMOSTASIS IN SHOULDER- AND HIP-JOINT AMPUTATIONS[1]

By WALTER A. NORTON, M. D., Savannah, Georgia

MANY attempts have been made in the past to control hæmorrhage in shoulder- and hip-joint amputations. It is a subject the study of which is both interesting and useful, and, according to the late Nicholas Senn, we must be free to admit that it constitutes by no means a closed chapter. A mastery of the technique of hæmostasis is an essential prerequisite to successful surgery. The presence of blood in a wound not only retards ideal healing, but also interferes with speedy work. "Extravasated blood is a dead substance, and must be so regarded by the surgeon." It is therefore incumbent upon every surgeon to adopt the simplest methods for making all operative fields as bloodless as possible. It might be well to delve into the history of these subjects and note the various steps which have led up to the present methods.

The first hip-joint amputation performed in America, and the first successful one in the world,[2] was done by Brashear of Bardstown, Kentucky, in 1806. He amputated the thigh of a colored boy in the lower third, and then enucleated the femur through a long external incision.

Bloodless amputations of the shoulder and hip were first attempted by making compression upon the aorta near its bifurcation. Pressure was exerted upon the abdominal wall, the vessel being interposed between the wall and the spine. Tourniquets for the purpose were devised by Esmarch, Tiemann, Lister and others, but the method was soon abandoned because of the immediate risk to life. Later in hip-joint amputations Davy sought to control hæmorrhage by introducing a blunt rod of wood or metal into the rectum and directing pressure upon the common iliac. The directions given by Davy were as follows:

"Oil having been injected into the bowel, the conic end of the rod is introduced into the rectum and passed in the direction of the vessel to be compressed, the surgeon feeling the end of the rod through the abdominal wall, directing it to the common iliac as it lies upon the pelvic brim. The handle is now carried to the opposite side and raised so that it may act as a lever, the anus serving as a fulcrum." This also was unsatisfactory, and preliminary ligation of the common femoral or external iliac for hip-joint, and subclavian or axillary for shoulder-joint was advocated, but not until the surgical genius of Esmarch introduced the elastic bandage was any decided advance made in this line. Following the general use of the Esmarch bandage Jordan Lloyd advocated controlling hip-joint hæmorrhage by compressing a calico roller bandage over the external iliac, retaining it in position by pinning it to a black india rubber bandage two yards long. "The center of this bandage rested between the tuberosity of the ischium and the anus, and the ends drawn tight were held by an assistant at a point corresponding to the center of the iliac crest of the side to be operated upon." Finally, in 1889, Wyeth devised a bloodless operation for amputation at the shoulder by elastic constriction over the scapula and pectoral region, and at this operation the applicability of this same idea to hip-joint amputations occurred to him, and in less than a year he performed his first bloodless amputation at the hip. He advocated, as you all know, the use of ordinary mattress needles ten inches long, introduced in the following manner:

For the shoulder, the first needle was introduced at the middle of the anterior axillary fold and brought out an inch external to tip of the acromion process. The other entered at the middle of the posterior axillary fold and emerged an inch external to tip of the acromion process. For the hip-joint amputations, the first needle was introduced one-fourth of an inch below the anterior superior spine of the ilium, and traversed the tissues for three inches emerging on the outer side of hip—direction being at right angles to plane of body. The second needle was thrust through the skin and tendon of origin of adductor longus half an inch below crotch, and emerging an inch below the tuberosity of the ischium.

The method of Wyeth seemed to solve the problem and had an extensive use in this country and Europe, the death rate falling from hip-joint amputations, according to Wyeth's paper,[3] from 93 per cent to between 40 and 50 per cent.

There are five points of importance which I would mention in shoulder-joint amputations:

[2] Bryant and Buck's Surgery, Vol. iv.

[3] J. Am. M. Ass., 1910, April 16.

[1] Read before the Medical Association of Georgia, Section on Surgery, Savannah, Georgia, April 17, 1913.

1. Ordinary compression of Esmarch bandage around shoulder without the use of Wyeth's needles, or some other method which will hold the tourniquet absolutely in position is not at all certain, because the rubber tourniquet will invariably slip down into the groove below the acromion process and cause such pressure as to greatly interfere with disarticulation.

2. It will also cause diminished pressure by slipping and give rise to embarrassing hæmorrhage after the operation is well under way.

3. In any of the accepted methods of operation either in the deltoid "U" flap, anterior racquet or double flap, place the ligature below the origin of posterior circumflex in tying the axillary, for this vessel furnishes nourishment for the flap, which if destroyed might seriously impair its vitality.

4. Allow no air to enter the axillary vein when tying, as it may give rise to air embolism.

5. In all methods, skin incision should be made and dissected up slightly before carrying incision through muscles.

Finally, many text-books will tell us that the safest and best way to control hæmorrhage in shoulder-joints, as well as in hip-joint amputations, is to employ Wyeth's needles.[1] By a much simpler method we can perfectly control hæmorrhage in shoulder- and hip-joint amputations, as I have proved in several amputations done by me within the past eighteen months.

[1] Senn, International, etc.

Only within the past two weeks, and since this paper was first written, have I found in Binney's Surgery, 1913 edition, the barest mention of a slightly similar method advocated for use in shoulder-joint amputation only.

It seems almost incredible that the old method of Wyeth's needles is still recommended in the latest text-books,[1] when a simpler and less barbarous procedure will accomplish the same result. Thinking it may prove useful, I will explain a method which can be used absolutely without an assistant if desired, and will control hæmorrhage at the hip as well as at the shoulder. It is as follows:

A four-inch roller bandage and an Esmarch rubber tourniquet is all that is needed. The four inch bandage is made into a 3 or 4 ply strip two yards long and laid upon the chest, extending over the shoulder; another similar strip is held over the scapula, the Esmarch tourniquet is applied over these two strips and pinned to each one with safety pins. The strips are simply folded back and handed to the nurse, or can be tied under the opposite arm.

For hip-joint amputation an anterior strip of bandage is placed so that the outer border of the bandage touches the anterior superior spine of ilium, and the posterior one is placed so that the inner border of the bandage touches the tuberosity of ischium. Pull is exerted so as to keep the Esmarch snug in the crotch and in the groove below the anterior superior spine of the ilium. The bandage pulleys are now passed over the shoulder of the other side and handed to the nurse, or better still tied securely.

Many neoplasms, angioma, fibroma, sarcoma, carcinoma and keloid, occur in the shoulder; it is the most frequent site of lipoma.[1]

I maintain that in the above mentioned conditions this method is superior to Wyeth's needles or preliminary ligations for obvious reasons.

The advantages of this method are,

1. You always have a bandage at hand, and may not have Wyeth's needles.
2. You do not impair already lacerated tissues by introducing the needles, for these cases are nearly all traumatic and you are often sorely taxed to find tissue for a flap.
3. The assistant holding the bandage (if they be not tied) can exert pull above or below as you progress with your work and occasion demands.
4. By this method you do not open up fresh fields for infection, as you frequently have conditions that make asepsis difficult, and as you must necessarily do in introducing Wyeth's needles.
5. Any procedure which will shorten the time of operation, and thereby lessen shock, is desirable, and precision in planning little details which will contribute toward making surgery an exact procedure should be carried out.

[1] Bryant and Buck's Surgery.

[1] System of Surgery. v. Bergmann, Vol. iii.

---

# A NEW DIAGNOSTIC SIGN IN INJURIES OF THE ABDOMINAL VISCERA[1]

By E. B. CLAYBROOK, M. D., Cumberland, Maryland

THERE is no condition that the physician is called upon to face that calls for better judgment, or causes him more anxiety, than those cases in which there is ground for the suspicion of internal injury. In these cases the surgeon is often at a loss to decide whether the conditions warrant an immediate laparotomy or a policy of watching and waiting.

In my experience, in this class of cases, I feel that if we wait for the classical symptoms to appear, the patient will be in such shape when operated upon that recovery will be the exception rather than the rule. Anything that can be brought forward to aid us in deciding this question will be of inestimable benefit to these unfortunate patients and a source of much gratification to the surgeon.

In a paper read at the one hundred and sixth annual meeting of the Medical and Chirurgical Faculty of Maryland, in 1904, entitled "Rupture of the bowel without external evidence of injury, with report of a case," I called attention to a symptom noted in that case as very prominent and noticeable. It consisted in the transmission of the heart and respiratory sounds, so that they could be heard all over the abdomen almost as well as over the chest. The ear was all that was needed to elicit the symptom, and if it was of any

[1] Read at the twenty-fourth annual meeting B. and O. Association Railway Surgeons, Pittsburgh, Pa., June 10, 1913.

special value it was doubly valuable on that account, for often the very life of these patients depends upon the attitude of the doctor who first sees them. At that time I stated that I did not know the mechanics that entered into the production of the sign, its value, or its significance.

In the past nine years I have looked for this sign, in all cases coming under my care, in which there was the slightest chance of an internal injury. After following these cases up closely, I have come to the conclusion that the sign is, when present, a positive indication for immediate laparotomy, whether the other signs present indicate grave trouble or not. It is present soon after the reception of the injury, and has been noted as early as a half hour after the reception of the injury. It continues in unoperated cases as long as twenty-four hours after injury, to my personal knowledge, and may last for days.

I believe that it is due to the irritation of the parietal peritoneum by the sudden outpouring of foreign material, as bowel content, blood and urine, into the abdominal cavity. It is never present in cases of extraperitoneal rupture of the bladder, or in injuries of the abdominal wall, without internal injury. I did not find it present in a case of rupture of the liver, in which the rupture was small, and down in the lobus Spigelii with the blood confined by liver, stomach, and omentum so that the parietal peritoneum was not flooded. In one case of severe bowel injury I failed to find it although the abdomen was full of blood. I do not know how to account for its absence in this case, and until we know more about it I think it wise not to look upon its absence as indicating no internal injury. I am positive that abdominal rigidity has no bearing on the production of the sign, as I have found it in perfectly soft, flaccid abdomens, as well as in those that were rigid. The fluid itself could not be responsible, for it is too little in amount in many cases, and besides fluids do not carry these sounds as well as gas, or the tissues.

I have found the sign present in cases of ruptured mesentery with hæmorrhage, ruptured spleen, ruptured bowel, ruptured liver, ruptured tubal pregnancy, and immediately after rupture of an appendix. It should be present in ruptured gastric and duodenal ulcer, as it is in cases of typhoid perforation. It should be of value in differentiating ruptured gastric and duodenal ulcer from appendicitis, as it will appear at once in these cases, and not in appendicitis until rupture has occurred. It is not present in post-operative cases. It was noted in one case doing badly after appendectomy, but as the patient was doing fairly well it was deemed best to watch and wait. After a week, the cul-de-sac being full and fluctuating, it was opened, and a large amount of blood and clot removed, due to a slipped ligature on the meso-appendix.

In a case sent in, with a history of a squeeze through the hips and abdomen, and catheter showing a small amount of bloody urine, the sign was not present. But with this history and the findings present it was thought safer to open him up. This was done, and showed no trouble intraperitoneally. The abdominal wall was severely contused, the space of Retzius contained some clot, and the bladder was contused, with a possible small laceration of the mucous membrane.

This sign is clear and distinct when it is present and can be elicited without any instrument whatever by anyone who has one good ear. I therefore think it should always be looked for, and when it is present the abdomen should be opened as soon as the patient can be moved to a hospital, or if that is impossible, or too time consuming, as soon as it can be done at home. The sign is not found in a slowly developing effusion, as in peritonitis or ascites. I hope that it will be followed up and some one will be able to find just what causes the transmission, and how much it can be relied upon as a negative as well as positive sign of internal injury.

# HABITUAL OR RECURRENT DISLOCATION OF THE SHOULDER

## Eighteen Shoulders Operated On in Sixteen Patients. A New Axillary Operation

By T. TURNER THOMAS, M. D., Philadelphia

CAPSULORRHAPHY for the cure of recurrent dislocations of the shoulder is gaining favor slowly, but much less rapidly than it deserves. It is an interesting fact that while a fairly thorough search of the literature showed the results to be almost uniformly favorable, a second paper by the same surgeon was not found. Various explanations could be offered for this fact, but they would all be included in the statement that the operation and its reported results lack the confidence of the profession. Perthes alone reported as many as four cases on which this operation had been done, most of the surgeons reporting cases having operated only once. Greater experience increases my confidence in the efficacy of the operation and throws new light on the etiology and pathology of the condition. The exposure of the capsule through an incision posterior to the axillary vessels has advantages which will probably increase confidence in the operation.

The frequency of these cases has not been established, even approximately, but they are undoubtedly much more frequent than previously thought. According to my experience, they are much more frequent than old unreduced dislocations, but much less obvious to other people, patients sometimes having the condition unknown to intimate friends. They are not prone to discuss freely their weakness, but would be glad of a cure. They are not anxious, however, to undergo an operation which is not well established and is not generally recommended. Burrell, who was one of the earliest in this country to do this operation, called it an anatomical operation. The occasional operator, without a good anatomical knowledge of the route by which the capsule is to be exposed, should not undertake it. With such a knowledge it becomes remarkably safe and very effective. The condition is merely a hernia of the joint, and the operation is, in my opinion, more safe and effective than the Bassini operation for inguinal hernia. How much violence a shoulder will stand after the operation has not yet been demonstrated, but the cases here reported show some interesting results in this respect. In one of my epileptic cases, recurrence followed each of my two operations, but I am confident that early operation would have prevented it in this case. A partial excision of the humeral head is probably the only operation which will now prevent it. In another epileptic, the reshaping of a deficient glenoid cup was necessary for a cure. In three other epileptics there have been no recurrences since operation, although in one there have been as many as sixty-eight epileptic attacks since operation.

The history of capsulorrhaphy is largely one of changing technique. Perthes varied the method of exposing the capsule in each of his four cases, and his experience illustrates in an interesting manner the difficulty of exposing the shoulder capsule for a plastic operation on it. In his first case he carried the incision from the coracoid process along the anterior margin of the deltoid nearly to its insertion, and, after dividing it near its insertion, turned the incision upward along the posterior border of the muscle to about its middle. The large flap thus formed permitted a free exposure of the joint without injuring the circumflex nerve. In the second case an incision was made along the spine of the scapula and acromion and a 0.5 to 0.75 cm. strip of these bones was separated by the chisel, to be wired in place later. In his third case he made an incision along the anterior margin of the deltoid. Above the coracoid process the fibers of the deltoid were divided up to the clavicle. One centimeter from its tip the coracoid process was sawed through and the tip turned downward with its attached muscles. The pectoralis major was later divided for retraction inward. The particular object was to expose the anterior glenoid margin. In the fourth case he employed the usual anterior resection incision and partially divided the deltoid at its origin from the clavicle.

From a study of the cadaver I concluded to make the incision in the axilla, anterior to the large vessels and nerves. This operation was performed on twelve of the eighteen shoulders. It is still preferred to any of the operations previously done, but I do not expect to do it again unless for some special indication which I cannot now foresee. It has one disadvantage, which I sought to overcome, but without marked success after twelve operations. Exposure of the capsule is obtained only under constant,

strong traction on the edges of the wound, especially on the outer side. It was employed in two cases by Telford,[1] who regarded it as distinctly superior to other operations, and was referred to very favorably by Stimson.[2] The axillary route became much more valuable when the capsule was exposed through an incision behind the large vessels. This was suggested by the observation that the humeral head in passing to the dislocated position, did not push the axillary vessels and nerves in front of it, but came much nearer to the surface behind the vessels. The operation still remains an anatomical one, chiefly because of the position of the circumflex nerve, which, however, is more easily located and avoided than in the anterior operation. The anterior operation required from an hour to an hour and a half; the posterior can be done in from twenty minutes to a half hour. After the skin and fascia have been divided, exact attention must be paid to the anatomical route by which the capsule is to be exposed.

*Posterior axillary operation.* To better provide the necessary asepsis, the arm is surrounded by a sterile towel from and including the hand to the shoulder region, the towel being held in place by a sterile bandage. This will permit the necessary movement of the limb during the operation without endangering the asepsis. The arm is then placed on a small side table at a right angle or slightly more with the body. An incision four or five inches long is made posterior to the axillary vessels with its center over the humeral head, which is easily felt by deep palpation. The vessels cannot be located well by palpation, but if the incision is made where the posterior axillary fold muscles fuse with the arm it will be posterior to the vessels. When the skin and fascia have been cut, the handle of the knife will easily expose the glistening tendon of the latissimus dorsi in the bottom of the wound. Immediately above it will be found the subscapularis, which is not tendinous here. Through this muscular interspace is to be exposed the capsule which lies immediately under the subscapularis and adherent to it. This muscle, therefore, must be retracted upward and inward and can be separated from the capsule by the handle of the knife or the finger. Before this step is begun, however, the circumflex nerve and its accompanying vessels must be located. With the humeral head in the socket, they lie at the upper or humeral end of this muscular interspace. If the head is in the dislocated position, the nerve and its vessels may pass over the most prominent portion of the head, so that one may come down on them unexpectedly. I have done this several times without special risk to the nerve, but I prefer to have the head in the socket and know from the beginning more exactly where it is to be found. About two and a half inches below the circumflex, the dorsalis scapulæ branches of the subscapular vessels pass backward through this interspace. The latter may be divided between ligatures to permit a freer retraction upward of the subscapularis, but *not before the circumflex nerve and vessels have been identified.* I have not divided the dorsalis scapulæ vessels, except in one case in which one of the veins was opened. The retractor pushed them aside sufficiently to permit the upward retraction of the subscapularis. The exposure of the capsule obtained was not a free one, but was quite sufficient for the necessary work on it.

In three out of the seven cases in which this operation was done, not even a catgut ligature was necessary and there was very little oozing. In another case only two ligatures were applied. After locating by palpation the anterior glenoid margin and humeral head through the capsule, the latter is incised from the upper to the lower limits of the joint about midway between the glenoid and humeral attachments. The upper part cannot be seen, but is easily and safely cut by the knife or scissors under the guidance of the finger. The joint is then explored by the finger. A small piece of bone may be detected in the antero-inferior part of the joint, loosely attached by a fibrous pedicle or embedded in the capsule. In the latter case, it may be allowed to remain. I have never known a patient to complain of symptoms indicating a loose body in the shoulder joint in any of these cases. They are detached fragments of the anterior glenoid margin produced in the original dislocation; i.e., they are tear fractures. If sought for, there will be found, probably always, a more or less shallow groove in the postero-superior portion of the humeral head where it presses against the anterior glenoid margin in the dislocated position. A very deep groove of this kind was probably responsible for the failure of my two operations in one case to prevent recurrences. In most cases the defect is too shallow to have any influence on the result of capsulorrhaphy. With the head in the socket the margins of the capsule wound are overlapped.

The only case in which I have had operative trouble was one in which necrosis resulted from a capsule suture under too much tension. I have

[1] Lancet, Lond., 1912, August 3.
[2] Fractures and Dislocations, 1912 edit., p. 668.

guarded against this ever since. Soon afterward plain catgut was substituted for chromicized, then the number of capsule sutures was reduced, and in the last four cases no suture was left in, in two of these neither suture nor ligature being left in the wound. In two cases a long silk mattress suture was so introduced that the lower margin of the capsule incision was drawn upward under the upper margin, the suture being clamped near the capsule by a long forceps which answered temporarily for a knot.

In a more recent operation three such sutures were employed for more accurate overlapping. Interrupted catgut sutures were then passed through the skin margins of the wound but not tied. A small rubber drainage tube was passed upward under the subscapularis to the capsule. The joint being opened widely and the wound not being compressible by a bandage, an accumulation of fluid tends to form in the wound if a tube is not employed. I have never had occasion to regret using it, but on two occasions have regretted not using it. The introduction of a grooved director evacuated the accumulated fluid, and a small tube, used for a short time, prevented a reaccumulation. The tube is usually removed on the day following operation. When the skin sutures are in, the arm is brought nearer to the side of the body and the skin sutures tied. The arm is then brought as near to the side as is compatible with the removal of the forceps clamping the silk suture. When the forceps is unlocked, it is first pushed upward to tighten the suture, which is then easily withdrawn by pulling on one end. The overlapping of the capsule margins is thus maintained and cannot be disturbed afterward because the arm will not leave the side until after cicatricial union is complete. A number of layers of gauze are placed high in the axilla to cover the wound and the arm bandaged in the Velpeau position.

When the bandages are removed on the following day the dressing will be saturated with joint and wound secretions. The tube can then be removed and the dressings reapplied as before. Usually they need not be changed again for ten days or two weeks, when they are entirely removed and the patient allowed to pass the arm into the sleeves of his coat and shirt. He cannot now abduct the arm far enough, voluntarily, to produce a dislocation. An epileptic would require immobilization for about four weeks, because of the danger of an epileptic attack before this time. At the end of the third week a non-epileptic patient should begin to force the arm upward anteriorly. At the end of the fourth week I permit him to use as much force as he can, actively, and at the end of the fifth week as much as he can, passively, in forcing the arm upward. This is the only movement I insist upon, and it is easily carried out by the patient by climbing a hanging rope, hanging from a horizontal bar, or creeping up the side wall with his hand, marking his progress from day to day. When he can raise the hand on the affected side as high as on the other, all movements of the shoulder-joint will be about normal. After the posterior axillary operation, return of normal movement is much more rapid and less troublesome than after the anterior operation, because the large vessels and nerves are not involved in the cicatrix and only the shortened capsule requires stretching.

The advantages of the anterior axillary operation over others previously employed have been discussed elsewhere.[1] Briefly they are as follows: The incision is only five or six inches long; it leads directly to the portion of capsule to be shortened, gives perfectly dependent drainage and divides only one muscle, the subscapularis, half-way across. The advantages of the posterior axillary operation over the anterior may be summarized as follows: (1) The wound is smaller. (2) The large axillary vessels and nerves are not exposed, and the circumflex nerve and its vessels are more easily exposed, identified and safeguarded. (3) The anterior circumflex vessels are always divided in the anterior operation, never in the posterior. (4) Access to the capsule is much easier and more rapid. (5) No muscles are divided. (6) There is practically no hæmorrhage; in the anterior operation there was always considerable oozing. (7) The time of operation is only about a third of that necessary for the anterior. (8) Return of normal motion is much more rapidly and easily obtained. (9) The elimination of buried material, as ligatures and sutures, and the small direct wound to the capsule in the dependent position, reduce the risk of operation to a minimum. If it were not for the position of the circumflex nerve and the opening of the joint, the operation on the early, uncomplicated case might properly be placed with the minor operations.

All the cases operated on are included here, the four already reported to show how they have progressed since. Details are sacrificed for brevity, except where they concern phases of the condition and operation not previously brought forward. The patients have all been heard from very recently.

[1] Am. J. M. Sc., 1909, March 12, 834.

CASE 1. Athlete, 23 years old at time of operation. First dislocation in a football game in 1904. Wore shoulder brace for several years, but dislocations recurred while wearing it. Operated on Jan. 18, 1908. Obtained practically full motion in eight to ten weeks, and later absolutely full motion. Has never had a dislocation since, although he has used the arm violently in many ways, as in gymnasium work and semi-professional boxing.

CASE 2. Coal miner, 42 years old at time of operation. First dislocation 25 to 30 years before. Recurrences finally became so frequent that at times they would occur every day, sometimes two and three times a day, and sometimes while asleep in bed. Had to give up all work because he feared to take the arm from his side. Operated on Jan. 30, 1909. Thirteen weeks later he fell headlong from a balcony over a railing which was 17 feet from the ground. He evidently struck on his hands with the arms in abduction, a position particularly likely to produce the dislocation. He had a long wound of the scalp and a probable fracture of the skull which confined him to bed for nine weeks and left him with disturbed mentality for months afterward. He still complains of intracranial troubles. He later returned to his work in the coal mines, has never had a dislocation since the operation, and believes that this arm is the strongest part of his body now.

CASE 3. Hospital orderly, 26 years old at time of operation. First dislocation in May, 1904. Was operated on July 2, 1906, for the purpose of shortening the capsule. The dislocations recurred after this operation. March 26, 1909, he was again operated on, but recurrence again followed the operation. I did the third operation June 6, 1909. He has had no dislocations since, but he has had other troubles. These began with a strangulation necrosis of the capsule resulting from a chromicized mattress suture applied under too much tension and grasping too much tissue, because of my anxiety to prevent further dislocations. The discharging sinus healed completely soon after the appearance in the dressing of the almost intact catgut suture. The return of motion was much slower in this than in any of the preceding cases, abduction being limited to about 140 degrees at the end of about a year and a half. At this time he had been training a young professional boxer for months, and the exercises had become very vigorous and even violent, the patient being able to strike almost, if not quite, as hard a blow with the affected as with the unaffected arm. One day in boxing he had severe pain in the affected shoulder, but continued the boxing. He did not report to me for a month later. During this time, and for a month after reporting to me, he continued to work as a railroad brakeman. He localized the pain on movement to the posterior part of the shoulder. I concluded that he had ruptured a few fibers of the deltoid and that they would ultimately heal without much trouble. About a month later he returned showing a small lump in the region of the chief pain, about the size of a cherry. This was incised and a small quantity of pus evacuated. The sinus persisted and limitation of movement indicated that the joint was involved, although the pain and swelling usual to this condition were not present. There was little change by June, 1912, except that the stiffness of the joint was more marked. By this time I had concluded that during boxing, in a violent abduction or external rotation movement, the overlapped and now very strong capsule sustained the force, and, instead of giving way itself, had torn away a fragment of the anterior glenoid margin. On opening the joint June 6, 1912, an irregular projection of this portion of the cup was found, and a probe passed into the joint through the sinus appeared in the joint just below this glenoid projection. The anterior operative wound was closed and the sinus enlarged for better drainage. Many times the sinus closed only to open again. Finally on May 27, 1913, the head of the humerus was excised. The wound closed in seven weeks. The movement of the new shoulder-joint, while slight, is increasing continually, the power of the whole limb is returning very favorably, and the patient has a very useful arm from the excision. He was formerly a semi-professional baseball player, and since the operation has played through several baseball games with considerable success, the movement of the scapula providing a fair range of movement of the arm.

If I had seen the patient immediately after the first occurrence of the pain in boxing and had then interpreted properly the cause of it, immobilization of the arm at the side would have brought the fragments accurately together. In five or six weeks good union would undoubtedly have taken place and in a short time the motion of the joint would have been about as free as before the accident. The patient's failure at first, and mine later, to appreciate the gravity of the condition, led to necrosis and suppuration with sinus formation, and finally to excision of the joint. But excision was the operation of choice before capsulorrhaphy was introduced. The necessity for excision in this case was due primarily to a capsule suture, and this fact has led me to abandon the capsule sutures entirely, so that such a complication cannot occur again.

CASE 4. Man, 21 years old at time of operation. First dislocation 5 years before from a fall in an epileptic attack. Has had twelve dislocations, most of them in epileptic attacks. First operation Oct. 16, 1909. About ten weeks after operation, when he had practically full motion in the shoulder, the patient reported that after an epileptic attack his shoulder, which had been operated on, would be painful. Soon afterward he reported that the dislocation had recurred, but that the head was not as far out as before the operation. Later they were as complete as before operation. Second operation, Nov. 15, 1911, at University Hospital, before members of Surgical Congress. Incision posterior to axillary vessels, with humeral head in dislocated position. Circumflex nerve found crossing most prominent portion of head. Several small vessels divided —probably branches of dorsalis scapulæ. Capsule found to be about half an inch thick from previous overlapping. Edges of incision in capsule again overlapped by catgut sutures; small gauze drain to arrest venous hæmorrhage; dressing and Velpeau bandage. Drain removed in 48 hours. Skin sutures removed and patient left hospital 4 days after operation. Velpeau position maintained four weeks. Could then abduct arm only to 45 degrees and external rotation was very slight. Continued to bind the arm to the side at night. Seven weeks after this operation he had a dislocation while in bed with the arm bound to the side. Has been having them ever since and they are now more frequent than before the first operation.

The defect in the posterior and upper portion of the humeral head was unusually deep and wide at time of first operation and it had grown larger at time of the second operation. The epileptic convulsions in this case are unusually strong and with the large defect in the head made a condition which capsulorrhaphy probably will not cure. Only excision or arthrodesis will prevent the recurrences now.

My conception of the part played by the defect in such a case as this is as follows: In the normal shoulder, bony contact is maintained at all times between the head and glenoid cavity, even in the extremes of normal movement. In extreme

abduction the axillary portion of the capsule must first tear extensively, the outer surface of the surgical neck must strike the edge of the acromion and the head must be pried out of the socket, before a dislocation can occur. In such a case as this one, the resistance of bony contact between the head and glenoid is lost as soon as abduction has been carried far enough to bring the deficient portion of the head opposite the anterior glenoid margin. The only resistance which then prevents an anterior dislocation is that of the anterior portion of the capsule, which gradually yields to the powerful contractions of the axillary fold muscles in the successive epileptic attacks. As soon as the groove in the head fits accurately to the anterior glenoid margin, the pressure of which in the dislocated position produced the groove, the head will be in the fully dislocated position. When the groove in the head is very small and the patient is not an epileptic, the cure seems to be permanent and the shoulder very strong. Even in most epileptics, as my cases show, the dislocations do not recur after capsulorrhaphy. The lesson which this case teaches is that capsulorrhaphy may be delayed so long, particularly in an epileptic, that this operation may not suffice for a cure.

CASE 5. Medical student, 20 years old; athlete. Referred by Prof. R. Tait McKenzie. Right shoulder dislocated in September, 1908, while playing football. Arm not bound to side after reduction and patient played football again same day. Second dislocation about a month later from throwing a stone. Has had about eight dislocations all together, some while asleep in bed. Can fully abduct arm without producing dislocation, but avoids this movement as much as possible. At first he gave up all athletics except swimming, and after having three dislocations in six attempts at swimming gave up this exercise also. Operation Nov. 23, 1909, in University Hospital on service of Prof. J. William White. Incision anterior to axillary vessels. Loose piece of bone attached by fibrous band found in lower part of joint, and a corresponding defect in anterior glenoid margin. It was clearly a detached fragment of the glenoid and was about ¾ in. long and ¼ in. wide and thick. Operation completed as usual. Small drainage tube removed on following day and patient allowed out of bed. Skin sutures removed and patient left hospital 5 days after operation. Prof. McKenzie took charge of exercises to restore motion, which was normal in four weeks. About six weeks after operation, was thrown from a sled while coasting and went down an enbankment, without injury to the shoulder. During following summer played tennis and swam a good deal. On one occasion a heavy boat, which he was using in swimming, turned over in shallow water. While trying to turn it right side up, he had almost succeeded, when it turned backward again. He attempted to prevent this backward turn with the arm operated on, which required a very strong effort on his part and resulted in a violent wrenching of the shoulder in abduction and external rotation. There was momentarily the sensation of the head jumping out of the socket. On his return to college that fall he began to play football. On one occasion he fell headlong with the affected arm in extreme abduction. He again experienced the same sensation as when trying to prevent the boat from turning backward. He has had no trouble in this shoulder since, although he has played tennis and baseball, and has done much swimming.

CASE 6. Man, 39 years old, chronic alcoholic and epileptic. Recurrent dislocation in both shoulders. Has been having epileptic attacks for 10 years. Had his first dislocation in left shoulder in an epileptic attack about two years ago. Arm bound to side after reduction by a physician, but patient removed bandage on following day and did not have it replaced afterward. Does not know how many dislocations he has had in this shoulder, but they recur, sometimes as frequently as four and five times a day. He can produce it voluntarily with the arm at the side of the body, which is very unusual, but the head tends to jump back into socket on slight muscular effort. About eight months after the left shoulder was first dislocated, the right was dislocated in an epileptic attack and recurrences have been taking place in this shoulder at variable periods since. He did not bind the arm to the side after the first nor any of the succeeding dislocations. He says that he can produce the dislocation in this shoulder voluntarily, but it gives so much pain that he does not care to do so.

Operation on right shoulder at University Hospital in service of Prof. J. William White, Dec. 11, 1909; operation on left shoulder Jan. 8, 1910, both through anterior axillary incisions. On passing finger into and examining this joint (left), it was found that the anterior half of the glenoid cavity was missing. Its posterior intact portion was represented by a strip of cartilage-covered cup, about half an inch wide, extending from the attachment of the long head of the biceps above to that of the long head of the triceps below, both of which attachments were intact. The whole anterior portion of the glenoid process had been worn away by the frequently repeated recurrences (often five or six a day), in the dislocated position the posterior portion of the head pressing strongly against the anterior glenoid margin. The effect of this condition on the glenoid was to produce a sloping surface from the posterior glenoid margin forward and inward into an abnormal pocket which received the head in the dislocated position. It seemed surprising that the head could stay in its normal position at all, yet it required considerable muscular effort on the part of the patient to dislocate it and only a little effort was necessary to cause it to jump back into the socket, where it would remain until forced out again. I had not expected to find this condition and had not received permission from the patient to do more than contract the capsule as in the right shoulder, and this was all that was done at this time. Primary healing; drainage tube removed on following day; arm kept bound to side of body for 25 days. On April 22d had almost full motion in right arm and could raise left arm above his head. Feels a "crack" in left shoulder from time to time, but has not had a dislocation in either shoulder since the operations.

The patient spends most of his time in institutions because of his alcoholism and epilepsy, so that I lost sight of him for a long time. In September, 1910, I looked him up to find how he had been getting along. He reported only two dislocations in the left shoulder and none in the right. He probably had had more in the left. In the following spring he came to me asking for another operation on the left shoulder and giving me permission to do what I thought necessary to prevent the dislocations. I operated on him in the Philadelphia Hospital, in the service of Dr. A. C. Wood, April 10, 1911. This operation consisted in chiseling away the posterior portion of the glenoid cavity through a posterior incision

until there remained a new cup with a slightly raised anterior margin (Hildebrand), and through an axillary incision cutting the capsule, freshening the sloping bony surface by a curette and packing the wound with gauze so as to cause the abnormal anterior pocket to become filled by cicatricial tissues and adhesion of the capsule. The posterior wound was closed completely and the anterior wound around the gauze packing. Dressing and Velpeau bandage; drain removed on third day; wound completely closed in three weeks. Has never had a dislocation in either shoulder since. There is still slight limitation of movement in the right shoulder and very little more in the left. If he had had ordinarily good habits, mentality and ambition, he could now have perfect motion in the right and practically perfect in the left shoulder.

CASE 7. Student and athlete, 19 years old. Referred by Prof. R. Tait McKenzie. Left shoulder first dislocated in November, 1907, in a football game. Arm not bound to side afterwards. Second dislocation in February, 1908, in a basket ball game. Chloroform necessary for reduction. Third dislocation two weeks later in a basket ball game and chloroform again necessary for reduction. Then gave up all athletics and did not have another dislocation until January, 1909, when it resulted from throwing a valise upon his shoulder. Reduced under chloroform anæsthesia. Operation Dec. 29, 1909, in University Hospital, in service of Prof. J. William White. Incision anterior to axillary vessels. Large nerve, evidently circumflex, seen passing over lower margin of subscapularis and disappearing through fibers of this muscle above. It was seen that the humeral head came through the subscapularis in each dislocation and that a considerable portion of the muscle had disappeared on this account. After dividing and lifting the remains of the muscle from the capsule, this was overlapped as usual by catgut sutures, the deficiency in the muscle being only partly closed. Patient left hospital in 5 days, and under Prof. McKenzie's charge obtained practically full motion in three weeks.

The after-course of this case has such an important bearing on what the shoulder can stand after operation that it will be briefly outlined: The patient began training for the crew of his university in February, 1910, but gave it up soon after the crew took to the river, from lack of confidence in the shoulder operated on. I then lost sight of him, until March 3, 1912. In the meantime he had gradually tested the shoulder to find what it would tolerate. During the summer of 1910, he played tennis, swam, and did other work of the same character. During the following winter he boxed a good deal. In October, 1911, on returning to college, he began wrestling in the gymnasium and soon decided to try for a place on the university team in the 158-lb. class. This required wrestling for practice from a half-hour to an hour each evening. In January, 1912, he was induced to enter the 175-lb. class. He weighed 165 lbs. and could increase his weight for the one class or reduce it for the other. In practice he would sometimes wrestle with men of 200 lbs. weight. Each contest with another institution was preceded by elimination trials to decide who should represent his university. The patient was the representative in his class in the contests with Columbia, Cornell, Lehigh and Princeton (on two occasions). He won his bouts in all except that with Lehigh, which was a draw, and in the second contest with Princeton, March 3, 1912, in which he sustained a mild upward dislocation of the outer end of the clavicle on the left side which corresponded to the shoulder operated on. At the time he thought that this shoulder joint had given way.

In October, 1912, he began wrestling again. In view of what the shoulder had stood without my knowledge, I did not interfere with his ambition to continue. He practiced at least three times a week, and, as the elimination trials approached, his wrestling became more frequent and violent. On the evening of November 25th, he had been engaged chiefly in practicing the release from the "three quarter Nelson" hold, which he would permit his opponent, a good wrestler weighing 165 lbs., to take beforehand. To release himself it was necessary to work himself into such a position that he could stand on his head and while in this position quickly spin his whole body around, at least twice, when he would have unloosened the hold of his opponent. This exercise had been practiced many times previously, and on this evening he had released himself five times successively. On the sixth trial he had completed the manœuvre and was free, but was on his hands and knees with the left arm at about a right angle with the body and his forehead touching the floor, when his opponent fell on this, the left shoulder. An anterior dislocation resulted and was reduced under nitrous oxide anæsthesia. The patient explains that in wrestling, he "works" with his left arm, which exposes the left shoulder to much the greater violence and twisting. This accounts for the dislocation of the left clavicle on March 3, 1912, and of the left shoulder on November 25th. That this was not an ordinary recurrence of a recurrent dislocation, in which the head jumps easily into a hernial sac waiting to receive it, was shown by the violence necessary to produce it. After such a recurrence, nothing is torn and in a few days the function is as good as before the recurrence. After the reduction of this dislocation, the shoulder was swollen and very painful; the arm was bound to the side for four weeks, and a month later no force had been used to overcome the limitation of movement in the shoulder, which was now very marked and resistant. On May 5, 1913, the shoulder motion was almost normal, and at the present time is normal, and there has been no further trouble in the joint. I believe that the dislocation was a new traumatic one, such as occurs from forced abduction in a previously normal joint; i.e., a new tear of the capsule was necessary, that this tear healed firmly and that the patient has now as strong a shoulder as one may expect after the ordinary traumatic dislocation of the shoulder.

CASE 8. Woman, 32 years old, epileptic for 11 years, referred by Dr. J. Hemphill, of West Chester, Pa. Had her first dislocation in an epileptic attack, 8 years before operation. Reduced on following day, but arm not bound to side afterward. At first the dislocations occurred only during epileptic attacks, but later, on the least exertion. It was easily reduced each time by some bystander. Operation at West Chester Hospital, January 19, 1911. The dislocation had remained unreduced since the last recurrence several months before, but was easily reduced at the time of operation, after a few manipulations to break up the limitation of movement, by traction on the arm held at right angles with the body. The usual operation was done through an anterior axillary incision. The hospital interne, Dr. Dorwarth, reported that the drainage tube was removed on the following day, that healing was by first intention, and that the patient left the hospital January 29th in splendid condition. Dr. Hemphill reported very recently that the patient has full motion and power of the limb operated on, and that she has never had a dislocation since the operation.

The following case was operated on by Dr. A. C. Wood. A brief report of it is included here, with his permission, in order, especially, to place on record another case in which the axillary opera-

tion was done, as well as to show the result of the operation.

CASE 9. Farmer, 21 years old at time of operation; now a medical student. In May, 1909, fell from a carriage to the ground, dislocating his left shoulder. Arm not bound to side after reduction, but was kept quiet at the side for about a week. Second dislocation several months later while climbing a tree. Recurs about once a month; at times, several times in one week. Generally succeeds in reducing dislocation himself. Operation at University Hospital, February 17, 1911. Incision anterior to axillary vessels, and capsule overlapped by catgut sutures. Small drainage tube employed, which was removed on following day. Primary healing. In a few months was able to do his usual work, has never had a dislocation since the operation, and has practically full motion in the shoulder and power in the affected limb.

CASE 10. Man, 24 years old; athlete. About 5 years before operation, dislocated right shoulder in a basket ball game. Reduced immediately by a fellow-player who pulled on the arm held in abduction. Patient continued to play and had second dislocation during same evening. Arm not bound to side after reduction, but he continued to use it afterward. Cannot recall time of next dislocation, but has had five or six in all, the last one on Christmas Eve, 1910. Did not work for five weeks after this because of the pain and disability. Shortly after the first dislocation of the right shoulder, he dislocated the left one in a basket ball game. This shoulder has been dislocated twice, at least,— how much oftener he cannot say, but he has not dislocated it for three or four years. Operation on right shoulder at University Hospital on service of Professor Edward Martin, Sept. 9, 1911. Usual operation through incision anterior to axillary vessels. Distinct groove found on posterior part of head at usual site. Small rubber-dam drain. On third day temperature rose to 101⅘°. Drain removed, grooved director introduced, and a considerable quantity of dark liquid blood evacuated. Drainage wound closed in two weeks and patient sent home to Scranton, Pa., a week later. Had practically full motion in eight weeks. Has continued his athletic work since, engaging particularly in gymnasium work, basket ball and baseball, but has not had further trouble in the shoulder operated on.

In January, 1913, while working in the gymnasium, he dislocated his left shoulder again, and since that time it has been out four or five times. Recently it was dislocated twice in the same evening, about fifteen minutes apart. He then decided that he would have this shoulder operated on also. This was done at the University Hospital, July 31, 1913, on the service of Professor Edward Martin, through a posterior axillary incision. The only points of interest in connection with the operation are as follows: The circumflex nerve was not found close to the humerus but lower in the middle of the field of operation so that it had to be guarded against more carefully than usual, and the lower fibers of the subscapularis were torn considerably by the strong retraction on it. Three silk mattress sutures were used in this case. The patient left the hospital at the end of one week, the city at the end of the second week, but kept the arm bandaged in the Velpeau position until the end of the third week.

CASE 11. Woman, 24 years old, epileptic since 15 years of age, referred by Dr. J. W. McConnell. Has had only two dislocations, the first March 16, and second, June 20, 1912, both during epileptic attacks and both while in bed. Operation July 15th, at University Hospital, in service of Professor Edward Martin. Incision posterior to axillary vessels. Finger in joint detected a shallow groove in head at usual site. Capsule overlapped by plain catgut sutures and operation completed in usual manner. Tube removed in 48 hours, skin sutures in five days, and patient left hospital at end of a week. All bandages removed at end of three weeks, but seventeen days after operation patient had two severe epileptic attacks on same day, and three months after operation fell headlong down a flight of stairs. Has almost full motion and had had 68 epileptic attacks (up to July 16, 1913) since operation, but has not had a dislocation.

CASE 12. Man 21 years old, epileptic, referred by Dr. J. H. Swaving of Pottsville, Pa. Ten years ago suffered from fracture of skull and eight years ago began to have epileptic convulsions. First dislocation of left shoulder about two years ago in an epileptic attack. Seems to have most of his attacks at night, and he thinks the dislocations have recurred at least two or three hundred times, a dislocation occurring with every convulsion. Recently it has been taking place whenever he lies on the left side, or abducts the arm suddenly. Says that two days before admission he had a series of convulsions and from that time to the day of admission, the dislocation has recurred about fifteen times. He is somewhat dull mentally and his statements may be unreliable, but he insists that they are true. I have obtained experimentally on the cadaver, on both sides of the same body, a condition almost exactly identical with that found in this patient's shoulder at operation. In both shoulders of the cadaver the dislocation could easily be reproduced on abducting the arm but could not be maintained on bringing the arm to the side of the body. Operation in University Hospital, in service of Prof. Edward Martin, July 16, 1912. Incision posterior to axillary vessels. Finger in the joint recognized a large movable fragment, representing almost the anterior half of the glenoid process. It is evident that in the first dislocation the anterior and lower part of the capsule had remained intact and had pulled away this fragment. In each dislocation the humeral head passed forward and downward between the two portions of the glenoid process, pushing the movable fragment away from its fellow. The head could not become locked in the dislocated position when the arm came to the side, as it does in the usual dislocation when the head passes over the anterior margin of the intact cup. There was a fairly large defect in the head at the usual site. After thoroughly curetting the adjacent surfaces of the two fragments of the glenoid process, I concluded to do the same with the surface of the groove in the humeral head. This was accomplished through an incision posterior to the deltoid, the tendon of the teres minor and the capsule being divided to gain access to the joint posteriorly. In addition to curetting the surface of the defect in the head, I also chiseled away the posterior margin of the glenoid cup, in order, if possible, to cause the head to rest more posteriorly on the cup. The posterior wound was closed without drainage, a dressing applied to the wound and the patient again placed on his back. Through the axillary wound the movable fragment was forced against its fellow as closely as possible and the capsule opening closed by gauze packing. Dressings were applied to both wounds and the arm bandaged in the Velpeau position. The gauze packing was removed in three days and was not reintroduced afterwards, the wound merely being covered by the gauze dressing. Skin sutures removed in seven days; wound closed in about three weeks, but the arm was immobilized in the Velpeau position for six weeks. My object was to obtain bony or firm fibrous union between the two fragments of the glenoid process and thus to reform the glenoid process, and to fill the defect in the head with granulation tissue and adhesions to the corresponding portion of the capsule. As was to be

expected, limitation of movement was severe when the dressings were removed. He was discharged July 28, 1912, and later readmitted to the institution for feeble-minded in Spring City, Pa. The physician in charge, Dr. H. M. Carey, reported that there had been no dislocations since his readmission, that the patient had a fair range of movement of the arm, but that he died March 30, 1913, from the effects of epilepsy.

CASE 13. Man, 31 years old, strong and vigorous, referred by Dr. C. E. Murrin, of Scranton, Pa. First dislocated his right shoulder 5 years before operation. Reduced by a physician and arm bound to side for three or four days, after which he used it as freely as the pain would permit. Does not know how many dislocations he has had. Had the last one about three weeks before operation, and another two weeks before that. From the beginning, pain has been severe for a few days after each dislocation and reduction. Operation at the West Side Hospital, Scranton, Pa., Sept. 24, 1912, Drs. Norman White and C. E. Murrin assisting. Usual operation through posterior axillary incision. No ligatures used; capsule overlapped by one No. 1 plain catgut suture. Shallow groove in posterior part of head at usual site; small rubber tube drain; catgut sutures for skin; Velpeau position. Tube removed in 24 hours. Left hospital in 4 days. Dr. Murrin reported (Oct. 29, 1912) that patient had almost full abduction, and Dec. 3, 1912, when I next saw him, he had full motion and excellent use of arm.

May 1, 1913, while driving a light wagon, his horse stumbled and fell. In hurriedly jumping from the wagon he had grasped the dashboard with his right hand and had one foot on the side step when the horse got up and toppled over again. This threw the weight of his body on the right arm, turning it backward in external rotation and abduction, and when he landed on the ground his right shoulder was dislocated. He did not have the arm bound to the body after reduction of the dislocation. Although he had been having recurrences every few weeks before operation, he has not had any more since May 1st, to date, August 20th, nearly four months. If he had reported the accident to me immediately, I would have had the arm bound to the side in the Velpeau position for at least three weeks. I believe that there must have been considerable laceration of the axillary portion of the capsule and that with three weeks' immobilization of the arm in abduction and internal rotation the important axillary portion of the capsule would have been cicatricially shortened again — perhaps more shortened than by the operation. This might have made the shoulder as strong or even stronger than before this last dislocation. He reports that it feels just as good as before this dislocation, that he uses it freely and that it seems perfect in every way, that he has "played baseball, lifted 50 and 75-lb. chests of tea, 100 and 125-lb. bags of coffee," and has been doing "pushing and lifting and heavy work around wagon."

CASE 14. Man, 26 years old, referred by Dr. J. J. Rutberg. First dislocation from falling downstairs with arm in hyperabduction. After reduction, arm bound to side for about 10 days or two weeks. In August, 1912, had his second dislocation, while trying to hold another person down on a couch, when the arm was forced into abduction. Had third dislocation Dec. 18, 1912, while in a trolley car which gave a lurch, wrenching the shoulder while he was grasping a handrail. The arm was still bound to the side when I first saw him Jan. 5, 1913. Operation at Stetson Hospital Jan. 8, 1913. Incision posterior to axillary vessels. Finger in joint recognized a shallow groove in head at usual site. Capsule overlapped by two long forceps, one grasping each margin of the capsule incision. Skin wound closed by No. 1 plain catgut sutures. No ligatures used in this case. When arm was brought close to side forceps employed to maintain overlapping of capsule margins removed. Small rubber tube for drainage; dressing; Velpeau bandage; tube removed in 24 hours. Patient left hospital at end of a week, when Velpeau bandage was removed and arm bound to side, the wrist being supported from the neck by a sling. All bandages removed at end of second week. Now has full motion and has had no dislocations since the operation.

CASE 15. Man, 21 years old, athlete, referred by Dr. F. P. Phillips of Clarion, Pa. First dislocation in a basket-ball game in the latter part of 1908. Arm not bound to side, but shoulder remained painful for a few weeks. Does not know how many dislocations he has had, but during past year they have recurred from slight provocation, as when he is in bed with his arm in abduction. Operation at Stetson Hospital, Jan. 29, 1913. Incision posterior to axillary vessels. Two ligatures were employed for a divided vein in the lower part of the wound, and there was some oozing that could not be controlled by forceps and ligatures because of its depth. Finger in joint found a shallow groove in head at usual site. Overlapping of capsule margins again accomplished by long forceps. No. 1 plain catgut sutures for skin wound; gauze drain for oozing; dressing; Velpeau bandage. Gauze drain removed on following day. Left hospital 6 days after operation, but remained in the city for another week, when all bandages were removed. Did not begin to force arm upward until beginning of fifth week. Two months after operation he wrote that he had "almost perfect action of the shoulder." More recently he wrote that he had been playing baseball and using the arm as vigorously in other ways, without disturbance of the shoulder, except an occasional pain.

CASE 16. Man, 52 years old, carpenter and ship steward. Had his first dislocation in 1891, while wrestling. A fellow-workman reduced it. Did not bind arm to side. Ever since has had marked limitation of abduction and external rotation. Cannot abduct much beyond a right angle. The arm gradually grew weaker with successive dislocations, which are very irregular as to the intervals between them, but they have grown in frequency and ease of production. They have occurred while he was asleep in bed. He can earn more money and prefers to work as a ship steward, but he gave this work up seven or eight years ago because of the absence of a physician on the ship and the risk involved in a rough sea. Operation at Philadelphia Hospital April 15, 1913, in service of Dr. A. C. Wood. Incision, three inches long, posterior to axillary vessels. Small groove in head of humerus at usual site. Edges of capsule incision overlapped by long silk suture which was later withdrawn. No ligatures employed; catgut for skin; small tube for drainage; dressing; Velpeau bandage; tube removed in 48 hours. Primary healing. All dressings removed April 28th, and arm placed in sleeves of shirt and coat. Remained in hospital until he could go to work. Discharged May 16, 1913. Said that he then had better motion and use and more power in arm than before operation and that the condition was improving continually. July 10, 1913, patient asked for and received my permission to go to sea again. He has had no dislocations since the operation.

## CONCLUSIONS

The operation of capsulorrhaphy cures in the great majority of cases. As performed in my last five cases, it involves very little operative trauma, primary union is obtained, and the patient may leave the hospital within a week.

Several of the patients returned to their usual occupations at the end of three weeks, and two students returned to their classes in one week.

Of the eighteen shoulders operated on, there were five in which the dislocation occurred after the operation. In one of them (Case 4), the large defect in the humeral head and the powerful epileptic convulsions made the case incurable by capsulorrhaphy. Early operation, when the defect was slight or absent, would have been effective, as shown by the successful results in three of the other five shoulders in epileptics. In Case 6, an epileptic, it was obvious at operation that the large defect in the glenoid cavity of the left shoulder would render capsulorrhaphy ineffective, although it reduced the frequency of the recurrences very much. As was proved by the second operation on this shoulder, capsulorrhaphy is sufficient for a cure of this condition, if the cup is reshaped. Early capsulorrhaphy, alone, would have been sufficient. The dislocation after operation in Case 7, in my opinion, was a new traumatic dislocation, such as that to which the normal shoulder is exposed. The two attempts of the humeral head to leave the socket, in Case 5, indicated that the capsule had not been sufficiently tightened by the operation, but the frequency with which he has exposed this shoulder to the violence of tennis and baseball playing, without a recurrence in nearly four years, indicates that the cure is permanent except for severe violence. This statement will probably hold true for Case 13 also. Of the 18 operations, therefore, it may be said that 16 were successful, one partically successful (Case 3), and one a failure, but even in this case the patient is no worse than he would have been without the operation.

The condition present in a recurrent dislocation is essentially that of a hernia of the joint, and the operation of capsulorrhaphy consists in the removal of the sac. It has one great advantage over operation for inguinal or other hernia. When recurrence after operation takes place in the latter, a cure cannot be expected without another operation. While in Cases 5 and 13 the operative shortening was probably not sufficient to prevent recurrence from severe violence, it was sufficient to compel some laceration of the capsule before a recurrence could take place. If in such a case, therefore, the arm is dressed in the Velpeau position for about three weeks afterwards, the cicatricial contraction of the torn and relaxed axillary portion of the capsule may make the joint as strong as it was made by the operation, or even stronger.

It is difficult to determine whether or not the shoulder can be as strong after operation as before. While I believe that it is not in these two cases, it is worthy of consideration that the right shoulder, which the patient would naturally expose to the greater violence, was involved in each case, and that severe violence was necessary to produce the dislocation in each instance. There have been no recurrences in either shoulder since, although nearly four years have passed in one case. In Case 10 the patient insists that the first or traumatic dislocation in the right shoulder, when it was normal, occurred from merely raising the arm to catch a basket-ball, which did not strike the arm, nor did he fall or sustain any other violence. If a dislocation had occurred since operation in this case, from such violence as produced it after operation in Cases 5 and 13, could we say that the shoulder was stronger or weaker than normal after operation? That a first dislocation of the shoulder can occur from slight violence is well known. I have one patient who dislocated her shoulder while sitting in a rocking chair from merely raising her arms in the act of "stretching."

Few normal shoulders are exposed to as much violence as was the one operated on in Case 7. That this one gave way after operation is to be explained by the fact that he did most of his work in wrestling with that arm and shoulder. The condition which developed in Case 3 is chargeable to the operation as then performed, but the cause responsible for it cannot develop from the operation as now performed.

In an epileptic, capsulorrhaphy is indicated after the first recurrence. It was performed at this stage in Case 11, and, although the patient has had as many as sixty-eight convulsions since, she has not had a recurrence of the dislocation since the operation. Spontaneous cure in an epileptic, after the first recurrence, is very improbable. It may occur in a non-epileptic, but is very rare, and the patient cannot be certain that he will not have a recurrence while he is in a dangerous position. I would advise operation in any case after the third or fourth dislocation, because I believe that the risk of operation is less than that involved in depending, for protection in danger, upon an arm the shoulder of which is easily dislocated. It is probable that every case is curable by capsulorrhaphy, when performed early, and almost every case when performed late; and that the only patients who will require a more severe operation are epileptics with large defects in the humeral head or glenoid cavity, both of which are due to repeated recurrences of the dislocation.

# THE SURGICAL TREATMENT OF BACILLUS COLI COMMUNIS INFECTION COMPLICATING PREGNANCY [1]

By EDWARD P. DAVIS, M. D., Philadelphia

BACILLUS coli communis infection complicating pregnancy manifests itself most frequently by infection of the appendix and of the right kidney. The following cases are illustrative:

Case 1. Italian multipara, aged 23 years, ill-nourished, ill seventeen days, pregnant seven months; continuous pain over right abdomen, vomiting and chills; pulse from 100 to 120; temperature from 101° to 103° F.; leucocytosis 26,600; urine, acid; abundant bacillus coli communis in pure culture. The left kidney could not be palpated, but the right kidney could be distinctly outlined and was considerably enlarged.

The patient was treated by rest in bed, milk diet, hexamethylenamine, purgation and the copious use of water, which failed to produce improvement. The advent of chills suggested the development of surgical kidney and the need for operation.

The right kidney was exposed by the usual lumbar incision. It was much enlarged and dark bluish in color. Stitches of chromicized catgut were passed through the two extremities of the capsule and the kidney incised along its convex border. An abundant flow of dark blood followed. The finger of the gloved hand was passed through the kidney substance to the pelvis and the opening dilated sufficiently to permit the introduction of a gauze drain. Blood from the kidney showed bacillus coli communis in abundance. The lumbar wound was closed at its extremities, leaving the center open for drainage.

An enlarged appendix was then exposed by the usual incision, and removed. It was in a condition of chronic inflammation. The patient immediately improved, and three weeks after operation came into spontaneous labor, giving birth to an infant 46 cm. long, and weighing 6 lbs. 8 oz. Both mother and child made an uninterrupted recovery.

Case 2. Patient aged 21 years, second pregnancy at five months; sent to the Maternity Department of the Jefferson Hospital from the examining room of the General Hospital, having been sent by a physician with a diagnosis of typhoid fever. The patient had characteristic symptoms of toxæmia with fever and intestinal disturbance.

On examination the red blood cells were 4,500,000; leucocytes, 20,000; hæmoglobin, 75 per cent. An acid urine contained bacillus coli communis in pure culture in abundance. No definite history of the duration of the patient's illness could be obtained, as she had been under treatment for typhoid fever for some time before admission. Neither kidney could be made out by palpation and the patient could give little information concerning her condition.

The right kidney was drained by the method employed in Case 1. The bacillus coli communis was found in abundance in the blood discharged from the kidney. The appendix was post-cæcal and was removed without difficulty. The patient's recovery was uninterrupted, and her pregnancy was undisturbed. She was discharged in good condition, as she preferred to be at home for her confinement.

Medicinal treatment in this case, prior to operation, was unavailing, and the patient's toxæmia and fever were steadily increasing when the decision to operate was made.

Case 3. A very ill-nourished Italian multipara, aged 38 years, was admitted to the Maternity Department of the Jefferson Hospital because she was pregnant and complained bitterly of severe pain in the lumbar region.

On examination the patient was emaciated, six months pregnant with a living child, profoundly toxic, and complained of severe pain in the right lumbar region. Her relaxed condition permitted the right kidney to be distinctly outlined, considerably enlarged.

Medicinal treatment failing, the appendix was first removed, inflamed and adherent. As no pus was present in the abdomen, and the appendix had not ruptured, the wound was closed without drainage. The right kidney was greatly enlarged, and an abundant flow of very dark blood followed its incision. This contained in great quantity the bacillus coli communis, and the blood was highly infectious as the edges of the wound became infected, and the wound healed by granulation in consequence. The kidney was drained by the method described.

Before operation the urine was highly acid, with abundant bacillus coli communis; the patient's leucocytosis was 25,000. She steadily improved, although the lumbar wound healed slowly, until two months after operation, when she gave spontaneous birth to an eight months' child. This was artificially cared for in the nursery of the Maternity. As the mother could not nurse the child, she went to her home to care for her other children, returning frequently to the Maternity to visit the child left in our care. The mother made an excellent recovery.

Since the publication of Opitz's (4) and Mirabeau's (3) papers, attention has been repeatedly drawn to bacillus coli communis infection of the kidney complicating pregnancy. Appendicitis in pregnancy has been so thoroughly investigated that time and space permit no separate attention to that subject.

Clinicians recognize infection of the right kidney as much more frequent than the left, and account for this in three ways: First, the ascending infection from bacillus coli invasion of the bladder and ureters; second, hæmatogenic infection from the circulation of infected blood through the kidneys; third, infection of the right kidney by the bacillus coli communis from the neighboring and often contiguous colon, the bacilli making their way through the wall of the intestine into the lymphatics by way of the ureter and surrounding tissues to the pelvis of the kidney. Clinical and experimental evidence establish these methods of infection.

[1] Read before the 17th International Congress of Medicine, London, August, 1913, Section on Obstetrics and Gynecology.

The predominant symptoms are those of toxæmia, with high leucocytosis, and acid urine containing bacillus coli communis in pure culture. The condition of the urine is significant and differentiates the infection from cystitis.

As Burnett (2) has shown, the bacillus coli communis does not decompose urea into ammonia, and hence the urine remains acid. It is also of interest to note that this germ does not produce an antitoxin.

The differential diagnosis of the more common form of pyelitis in pregnancy, that in the right kidney, is sometimes difficult. Often the kidney cannot be palpated distinctly, the patient's pain is referred to the right lower abdomen, or even to the upper portion of the abdomen and may suggest right-sided pleurisy, appendicitis, catarrhal infection of the gall-bladder, chronic constipation, renal calculi, or salpingitis.

From the pain alone an exact diagnosis cannot be made. Clinically the existence of appendicitis can never be denied in these cases. An intelligent history will often assist in making a differential diagnosis, and a careful physical examination of the chest may enable one to exclude pleurisy. The gall-bladder is so often invaded during pregnancy that a mild infection cannot be denied when indefinite pain and moderate disturbance of the pulse and temperature are present.

When we consider treatment, one may naturally inquire first, What would be the fate of these patients without medical attention? The development of surgical kidney, septicæmia, and death have been reported sufficiently often to show us that such is more than a possibility. In my observation, a patient who refused operation was critically ill for several weeks with repeated chills and fever, finally giving birth to a dead child, and making a tedious recovery. She, however, received good hospital care and medication.

The post-mortem appearances in these cases are learned from a very interesting report by Williamson and Barris (9) in an autopsy made upon a patient dying at St. Bartholomew's Hospital. The bladder was normal, the ureters dilated, containing purulent fluid from which pure cultures of bacteria were obtained. Small abscess cavities were found in the kidneys with degenerative changes in the tubular epithelia.

The patient from whom these specimens were obtained was treated by medicinal means and seemed to be improving, with normal temperature, when the ureters were catheterized under anæsthesia, to determine the condition of the renal pelves. This manipulation was followed by cyanosis, rapid breathing and death. In this case, the infection seemed to have come through the blood-stream. A pleural effusion was thought to be caused by the same organism.

Medicinal treatment is sufficiently successful in mild cases to warrant its prompt and thorough employment.

Andrews' (1) success in 19 cases at the London Hospital with medicinal treatment only, with one induction of labor, illustrates what can thus be accomplished. The essentials of this treatment are rest, milk diet, purgation, the use of salt solution by continuous instillation at intervals, and the administration of hexamethylenamine with local applications over the kidney. This treatment mitigates the patient's pain. It is a familiar observation with obstetricians that mild cases do well under this treatment.

When, however, this does not promptly control the case, and the leucocytosis increases, the patient's temperature is higher, chills develop, and the toxæmia is worse, more radical treatment is indicated.

The suggestion to induce labor or to empty the uterus is natural under the circumstances, but we believe mistaken. Stoeckel's (8) remark that pyelitis is a complication of pregnancy and that pregnancy is not a complication of pyelitis, is exceedingly pertinent. The obstetrical rule should prevail that in all cases of acute infection complicating pregnancy, labor should not be induced; that the complications should be treated, and nature allowed to take care of the pregnancy. It must be remembered that the goal of the obstetrician is the saving of both the life of the mother and child, and that no case can be considered completely successful which fails in this.

The induction of labor may add fuel to the fire, as illustrated in a case reported by Sauvage (7), where pregnancy was interrupted with the death of the child, and as improvement did not follow nephrotomy was practiced, followed by the death of the mother.

We cannot agree with Burnett (2) in his advocacy of the induction of labor.

The effort to drain and disinfect the kidney without incision is frequently made by catheterizing the ureters and irrigating the pelvis of the kidney. In favorable cases this may be done without anæsthesia, and good results are reported by those who have had experience in this treatment. In early pregnancy this method has been successful, and is certainly worthy of trial.

Neither medical treatment, the induction of labor, nor catheterization of the ureters with irrigation of the pelvis of the kidney, efficiently

deals with the infected condition often present in the right lower abdomen. Whether this be appendicitis or a possible salpingitis, it is essential that the abdomen be explored and the appendix or infected tube removed. As an aid in determining which kidney is enlarged and the degree of enlargement, pyelography by the X-ray has been successful in the Strassburg clinic, as reported by Schickele (6). By this method the kidneys may be distinctly outlined, and often the dilated ureters traced, and valuable information gained as regards the site and method of operation. Should the ureters be shown, by this method, to be greatly dilated, and both kidneys be involved, the case would be suitable for catheterization of the ureters, and irrigation of the kidneys. Should one kidney be distinctly palpable, it may be drained by incision, with the removal of the appendix; and should this not be sufficient, the ureters subsequently catheterized.

Operations upon the kidney in pregnancy should not be considered as the last resort, with an unfavorable prognosis. Pousson (5) at the French Congress of Gynecologists in 1910, in 66 cases of nephrectomy with following pregnancy had 59 patients delivered at term, most of them nursing their children, and one becoming a wet nurse. Pinard removed a tuberculous kidney, the patient afterward passing through a normal pregnancy. Within a few months in one of our wards, a pregnant woman from whom one kidney had been removed for tubercular infection recovered from eclampsia. In 8 of Israel's cases with tubercular kidney with nephrectomy, there occurred subsequently 15 pregnancies uncomplicated, followed by normal labor. Hartmann reported 113 renal operations on women, 35 during pregnancy and 78 followed afterward by pregnancy. Among the 351 cases collected was Cragin's vaginal nephrectomy for the removal of a displaced cystic kidney in the pelvis which was obstructing labor. This was followed by normal delivery. The experience of others coincides, and it is interesting to note that operations upon the kidney during pregnancy, accompanied by disturbance of the uterus, often do badly, while in cases where pregnancy remains undisturbed the prognosis is good. During pregnancy itself tuberculosis of the kidney is fortunately rare, as shown in the experience of Guy's Hospital, where in the last twenty years no case of pregnancy with tuberculous kidney has been observed.

I desire also to report a case of intestinal infection in which, by exclusion, the diagnosis of bacillus coli communis infection is most reasonable.

An ill-nourished primipara from semitropic regions, after spontaneous labor with living child, developed fever. Examination of the blood failed to reveal streptococci, nor were the usual signs of puerperal septic infection present. The fever was characterized by considerable elevation with sharp depression and rigors of moderate severity. As the patient did not improve and abscess could not be found, it was thought that possibly she had pyosalpinx, or some obscure collection of pus. Her symptoms were fever, malaise and diffuse abdominal pain without distention or resistance, while peristalsis, though impaired, was present.

On section the pelvic organs were normal, excepting a small fibroid nodule on the posterior wall of the uterus. The appendix was enlarged at its base, there were slight but recent adhesions between the coils of intestine, and part of the transverse and the entire descending colon was thickened, red, and at one point beneath the peritoneal covering showed an ulcerated portion. The appendix was removed, adhesions separated, the fibroid nodule removed from the uterus and a Mikulicz gauze bag placed at the bottom of the pelvis, with a cigarette drain to the former site of the appendix. These drains were gradually removed. The patient made a tedious recovery complicated by phlebitis of moderate severity. The Widal typhoid reaction was negative. Examination of the stools for amœbæ was negative. There was no evidence of syphilis or tuberculosis, and the most reasonable diagnosis was colon bacillus infection of the large bowel. The tip of the appendix was practically normal, the base thickened and red.

In the *American Journal of Obstetrics*, 1896, xxxiv, No. 2, I reported a cæsarean hysterectomy followed by death, with symptoms of abdominal infection. At autopsy the field of operation by bacteriological examination was sterile. The lining of the intestine was ulcerated and infection had spread from these ulcers to the lymphatics of the peritoneum. The tests for typhoid, syphilis, tuberculosis and streptococcus infection were negative. The history showed that shortly before coming into labor, the patient had taken violent irritant purgatives, hoping to terminate pregnancy with the death of the child.

We know that the colon bacillus is the germ most frequently present in the intestine, and most often producing infection of the intestine and surrounding viscera. Clinical infection from this source is characterized by moderate fever, with sharp descent, rigors, malaise and the absence of signs, in many cases, of abscess. Abdominal pain is often referred to the large bowel, especially in the region of the appendix. Many of these cases undoubtedly recover with medical treatment only, but where improvement in a reasonable time does not follow such treatment, the patient growing worse, I believe that section should be done. The appendix should be removed, adhesions loosened, collections of pus emptied and extensive drainage instituted. Salt solution should be given at the time of operation by intravenous injection, and afterward by the drop method in the bowel. Food must be limited

to substances leaving no residue and stimulation freely employed.

These cases are reported to call the attention of the profession to the feasibility of surgical treatment for this condition in severe cases which do not improve after a reasonable time, and while under accurate observation with medicinal treatment.

The bibliography of the most recent literature is appended.

BIBLIOGRAPHY

1. ANDREWS. Brit. M. J., 1912, May 18.
2. BURNETT. J. Obst. & Gynec. Brit. Emp., 1910, July and August.
3. MIRABEAU. Monatschr. f. Geburtsh. u. Gynäk., 1907, xxvi, No. 6.
4. OPITZ. Arch. f. Gynäk., 1907, viii.
5. POUSSON. Ann. di Ginec. d'Obstet., 1910, October, 674.
6. SCHICKELE. Arch. f. Gynäk., 1912, xcviii, No. 2.
7. SAUVAGE. Zentralbl. f. Gynäk., 1911, No. 6.
8. STOECKEL. Ztschr. f. gynäk. Urol., 1908, i, No. 1.
9. WILLIAMSON and BARRIS. J. Obst. & Gynec. Brit. Emp., 1911, November.

ALBRECHT. Zentralbl. f. Gynäk., 1913, No. 9.
CREW. Brit. M. J., 1912, April 13.
DOBSON. Brit. M. J., 1911, April 15.
FRENCH. Brit. M. J., 1908, May 2, 9, & 16.
GÖDECKE. Zentralbl. f. Gynäk., 1912, No. 15.
HUNNER. Surg., Gynec. & Obst., 1912, October.
KEHRER. Ztschr. f. gynäk. Urol., 1911, iii, No. 1.
KERMAUNER. Ztschr. f. gynäk. Urol., 1911, ii, 6.
MANSFELD. Verhandl. d. deutsch. Gesellsch f. Gynäk., 1911, xiv, 810
MARKUS. Berl. klin. Wchnschr., 1911, No. 17.
SCHMIDT. Deutscher med. Wchnschr., 1911, No. 29.
SONDERN. Bull. Lying-In Hosp., 1909, No. 1.
SIEBER. Zentralbl. f. Gynäk., 1912, No. 51.
VENUS. Wien. klin. Rundschau, 1911, Nos. 33 & 34.
WEINDLER. Zentralbl. f. Gynäk., 1909, No. 37.
WEIBEL. Arch. f. Gynäk., 1913, xcix, No. 2.

# A NOTE AS TO THE RECOGNITION OF THE URETER

## REPORT OF A CASE OF ANASTOMOSIS OF THE URETER INTO THE APPENDIX

BY WAYNE BABCOCK, M. D., PHILADELPHIA

DURING abdominal and especially pelvic operations it is ofttimes of advantage to quickly and positively recognize the ureter. While by painstaking search the ureter may usually be distinguished from other structures, if the tube is greatly displaced or embedded in new tissue or altered in caliber it may be found difficult to positively identify the structure.

Some time ago on exposing, by the extraperitoneal method, a ureter containing a stone, we found a tube of the size and thickness of small intestine. It so closely resembled bowel that for a moment we hesitated to incise it. It was found, however, to have periodic peristaltic movements which differed from those of the small bowel. They were excited by stroking the tube and they also occurred spontaneously at equal and rather frequent intervals of time. These movements were so pronounced that they could readily be demonstrated to students seated a number of feet from the operating table. Later on studying normal ureters during the course of intra-abdominal operations, the peristaltic movements were found to continue regularly during the course of the operation, and they could easily be seen through the overlying peritoneum.

We have thus, by the characteristic peristaltic waves, been able repeatedly to positively identify the ureter and to demonstrate it to others. Through the peritoneum the inosculating perirureteral blood-vessels that form fairly coarse oval loops may be seen. During the peristaltic wave the caliber of the tube is not only diminished but the ureter, marked by the attached vessels, may be seen to slide upward, and then after a momentary pause, downward under the peritoneum. The movements are quite rapid, cover several millimeters and are succeeded by a fairly long interval. In one patient recently we found the interval to be 28 seconds. On stroking the ureter it became 12 seconds. There is no other columnar or tubular structure in the body that shows this type of peristaltic movement. In the intestines the peristalsis takes the form of succeeding waves and in the ureter the contracting wave is usually less apparent, the chief impression being the longitudinal sliding or trombone movement. It suggests the intermittent sliding of valve rods seen on steam vessels. Although certain ureters show a primary change in diameter with elevation of the tube, intestinal movements also have not the same orderly succession of peristaltic movement, and instead of being excited by stroking or manipulation they usually soon cease after the abdominal cavity has been opened. Any surgeon who will, for a brief period of time, expose

the deep structures passing over to the pelvic brim in the region of the sacro-iliac synchondroses should be able to recognize the ureters by this simple method.

ANASTOMOSIS OF THE URETER INTO THE APPENDIX

Bernays Kennedy[1] suggests the feasibility and advantage of anastomosing the ureter into the appendix. This operation I carried out three years ago in the following case:

Mr. S. C., age 40, was admitted to the Samaritan Hospital April 1, 1910. He had an advanced carcinoma of the bladder with much cystitis and was emaciated, debilitated and toxic. On April 1, 1910, spinal anæsthesia was used, a suprapubic cystotomy was done, and the growth partially removed. It was found to be so extensive as to preclude any conservative operation. It was decided, therefore, to anastomose the ureters with the bowel in the hope of being able later to do a radical cystectomy. The advantage of introducing the ureter into the appendix suggested itself. It did not seem as feasible, however, with the septic suprapubic opening to introduce both ureters into this organ. On April 22, 1910, through an incision above the crest of the ilium, the retroperitoneal tissues upon the right side were exposed and the ureter isolated, divided and brought into the field. A small incision was then made through the posterior peritoneal wall and the appendix pulled through and made extraperitoneal. The tip of the appendix was excised and the end of the ureter affixed by fine sutures which were carried into the lumen of the appendix and through the appendicular wall. These were tightened and the end of the divided appendix united by other sutures to the adjacent wall of the ureter. It seemed desirable to have a portion of the ureter in contact with the appendix not lined by mucosa. The discrepancy in the size of the two tubes and the thick mucous lining of the appendix rendered it somewhat difficult to get a satisfactory and apparently water-tight approximation. The left ureter was divided and embedded in the rectum. The patient was a very unsatisfactory subject and progressively failed and died April 24, 1910. The extraperitoneal anastomosis was selected in order to avoid intraperitoneal leakage.

By closing the peritoneum carefully about the base of the appendix and avoiding any interference with the appendicular vessels and the mesoappendix the operation may be done with little danger of peritoneal infection. The anastomosis of both ureters into the appendix evidently would be a more difficult procedure and could be done more conveniently and with less ureteral displacement by an intraperitoneal operation. We are of the opinion that the operation of uretero-appendiceal anastomosis possesses no very great advantage, as it does not obviate the secondary cicatricial contraction of the divided end of the ureter, the stenosis thus produced being, we believe, one of the great causes of the secondary renal infections after these operations.

[1] Surg., Gynec. & Obst., 1912, xv, 464.

---

# A METHOD OF MARKING IMPORTANT FIELDS ON THE MICROSCOPIC SLIDE

By HARRY H. HART, Baltimore
Radiologist and Pathological Photographer, Private Hospital of Howard A. Kelly, M. D.

THE pathologist frequently finds a particularly good spot on the slide when examining a specimen under the microscope which it is desirable to mark for future use, especially when the specimen is to illustrate an article with photomicrograph or drawing.

I have devised a simple method of so marking which enables the pathologist to show his artist or photographer the exact field desired and also furnishes a guide in estimating the magnification of a given field in a given sized picture. A number of slides may be marked at one time and the illustrations made later.

The only appliances necessary are some square white gummed labels a trifle larger than the cover glass and a tool used by dentists, known as Ainsworth's rubber dam punch (Fig. 1). This has a rotary device for cutting various sized holes, from the size of a pin-point up to one of 2 mm. diameter.

A hole just including the field desired is punched in the center of one of the labels and the latter is then slipped over the slide and under the objective while the operator continues to view the field through the microscope. When the opening in the paper exactly coincides with the field of vision, the label is fastened to the cover-glass by moistening the corners only (Fig. 2). If, for instance, a circular picture of 90 mm. diameter at a magnification of 60 diameters is required, it will be necessary to punch a 1½ mm. hole. The field included in the finished picture will then be the same as that seen microscopically. The same plan may be used for high powers by decreasing the size of the punch-hole as the magnification is increased. When using

Fig. 1. Ainsworth rubber dam punch

this device for photomicrography, I usually loosen one end of the label and push it aside and get rid of any minute fibers of paper which might tend to obstruct the field, after the slide is properly centered and all is ready for the exposure of the negative.

The following methods of marking slides are the only ones in use heretofore which I have been able to find:

(*a*) Marking a circle on the cover-glass around the field with a pen and ink; a very crude method.

(*b*) Using a pointer of gummed paper pasted on the cover glass; this is useful to mark a particular object, but does not give a circumscribed field.[1]

[1] For a fuller description of methods B and C, see Paul N Hasluck's "Book of Photography." The brush marker (D) is described in detail by Professor Simon Henry Gage, in his standard work on the microscope.

Fig. 2. Slide with label in place.

(*c*) Maltwood's finder, consisting of a glass the size of a slide ruled in minute squares. Each square contains two numbers which serve to identify the horizontal and vertical position of the square. The specimen to be marked is correctly placed under the objective, and its position on the stage of the microscope noted by means of the mechanical stage. The slide is then removed and the finder substituted. The numbered square, or squares, which appear in the field will then serve to identify the field for future reference, it being necessary to place the slide in exactly the same position on the stage each time. This method would not be satisfactory with microscopes not fitted with mechanical stages.

(*d*) A marker consisting of an objective-like attachment which screws into the nose-piece of the microscope. This carries a small brush which is dipped in colored shellac, and made to rotate around the field, thus enclosing it within a dark ring. The position of the brush may be changed to vary the size of the circle.

# TRANSACTIONS OF SOCIETIES

## CHICAGO SURGICAL SOCIETY

REGULAR MEETING HELD NOVEMBER 7, 1913, WITH THE PRESIDENT, DR. M. L. HARRIS, IN THE CHAIR

Previous to the papers Dr. Bevan arose to a question of personal privilege and said:

DR. ARTHUR DEAN BEVAN: As a question of personal privilege I wish to correct a statement I made, I think, at the last meeting of the Chicago Surgical Society in regard to an apparatus which is made by Dr. Lemon, of Milwaukee. In a meeting before the Western Orthopedic Association, I understood Dr. Ridlon to say that this apparatus of Lemon, of Milwaukee, was a modification of one which he had modified from the Bartlett apparatus, of Boston, and I made that statement in a discussion before this society. Since that time Dr. Lemon and Dr. Ridlon have both called my attention to the fact that the apparatus which Dr. Ridlon referred to was not Dr. Lemon's apparatus, but the apparatus of another Milwaukee surgeon. As a question of personal privilege and in justice to Dr. Lemon, I desire to correct the statement made in a former discussion, so that this fact will appear in the minutes of the Chicago Surgical Society.

DR. ALFRED STRAUSS read a paper (by invitation) entitled "An Artificial Ureter Made from the Abdominal Wall." (See p. 78.)

### DISCUSSION

DR. L. L. MCARTHUR: I stand here simply as a sponsor for this paper and do not propose to enter into a discussion of it because I know very little about the experimental work that has been detailed to you this evening, but after seeing the slides and hearing the work of one of my former internes I felt that it was of such importance that the Surgical Society of Chicago was entitled to hear it first. I believe that the work is indicative of practical application to the human being and one which will be really epoch-making in the way of advance for the replacement of those portions of the ureter which are occasionally of necessity sacrificed in a surgical procedure or destroyed by disease or by neoplastic infiltrations. The work has been one of the first contributions which have come out of the new institution for scientific research at the Michael Reese Hospital, and is one worthy to be included in the volume of experimental research, one of which we, as members, of that institution are, I think, justly proud.

DR. DEAN LEWIS: The piece of work that has been described by Dr. Strauss is very interesting. Surgeons have been slow in inventing and adopting new procedures for the repair of ducts. Recently Dr. Carl Davis and myself have attempted to repair and reconstruct the common bile duct with living transplants, for reconstruction of the duct by a rubber tube, as recommended by Sullivan and Wilms, has never seemed to me to be entirely satisfactory. Fascia apparently is highly resistant to bile and urine, providing there is no infection. We have reconstructed the common bile duct by using free fascial transplants. After cutting the duct we have removed a piece of the sheath of the rectus muscle and have joined the two ends by a fascial tube, much as Dr. Strauss has united the ends of the divided ureter. The fascia has been transplanted free without a pedicle. The fascia lives, there being no evidence of necrosis. In practically all cases there has been some dilatation of the duct above the transplant, but bile has passed on into the intestine.

We have done the same thing with the ureter. The ureter has been divided and the two ends have been united by a fascial tube, the fascia being transplanted free. In the procedure employed by Dr. Strauss I do not believe that the pedicle is necessary to preserve the life of the transplant. There is more or less dilatation of the ureter above the transplant and some hydronephrosis, but urine passes beyond the point where the transplant was inserted. I believe that in both the common duct and ureter the dilatation above the point at which the transplant was inserted is due to an interruption of the rhythmical waves which pass over these ducts. I believe that the method can also be used to reconstruct the salivary ducts in cases

of salivary fistula. These fascial transplants are apparently easily killed by infection and this, of course, may prevent a wide application of the principle we have advocated.

DR. CARL BECK: The paper of Dr. Strauss is highly interesting, not only on account of the microscopical findings but also on account of the advantage of using local tissues for the first time as transplants. It seems to me, however, that another principle, which is much more simple, enters into this work. I have a case in which I have used it. Where there is a partial loss of the ureter other structures can be used. I refer to the principle of using a part of the bladder as a transplant. It is a principle which has been used in the formation of the œsophagus. Some years ago we showed such a specimen before the Chicago Medical Society in conjunction with some work I did with Dr. Carrel. It consisted of the formation of an œsophagus from a flap which was cut parallel to the large curvature of the stomach, then turned upward and formed into a tube which was joined to the œsophagus. This operation has recently been mentioned in the literature under other names than ours, but as our report of our experimental work was published only in the Proceedings of the Chicago Medical Society it has not found its way into the general literature. The same principle can be used to make quite a long ureter from the bladder, taking a portion of the wall and leaving it in connection with the wall, and so-called cysto-enterostomy by Boari, and using a flap as long as you want it. This work demonstrates that a considerable portion of the ureter can be replaced from the wall of the bladder. It is physiological tissue which can be used for reconstruction. The same can also be used for the common duct from the intestine.

DR. DANIEL N. EISENDRATH: The great difficulty, as has been pointed out by Dr. Strauss, with all ureteral plastics has been that the ureter sooner or later eats up the structure that you have transplanted on account of the irritating action of the ureter, and sooner or later becomes converted into cicatricial tissue which presses upon the proximal and distal portions of the ureter, in which we get stenosis at the point of transplantation with subsequent hydronephrosis. At the time, I thought that if we could get some structure which was accustomed to the presence of urine, like the urinary bladder itself, we might solve the problem of these transplantations successfully. I did not know at that time of Boari's work, and a free transplant was made between the ends of the ureter in the manner Dr. Strauss has carried out, believing that this would overcome any cicatricial tissue. We pursued a technique practically the same as that of Dr. Strauss, and as almost everyone would working in this field. Those who have used arteries or veins have inserted them between the ends and then sutured them, but the method pursued by myself and Dr. Strauss in a modified manner was to take the transplant and make a sort of pseudo-bladder of it. Dr. Strauss succeeded in uniting the distal edge, put in so as to project after the manner spoken of by Dr. Beck in the reimplantation of the intestine. We obtained a number of successful unions by this method. A number of the dogs died from sloughing of the flaps. The flaps did not live and we had perforation and urinary fistula, which would open toward the outside. At other times the urine would escape into the peritoneal cavity and we had peritonitis. The dogs that lived, as we found in our experiments, had hydronephrosis, the result of contraction of the transplant with dilatation above it.

DR. ALFRED STRAUSS (closing the discussion): With reference to the remarks made by Dr. Lewis concerning experiments on the bile ducts, his statement speaks in favor of my hypothesis regarding an acid or peculiar chemical reaction of the urine causing some slight degenerative change in the fascia which produces infiltration, cartilage formation and bone formation.

Another point which favors this hypothesis is the transplantation of fascia to bile ducts, the bile being an alkaline medium which causes no chemical irritation and therefore no changes in the fascia. For instance, I believe Dr. Lewis has transplanted the fascia lata into the abdominal wall and areolar fatty tissue, both of which have an alkaline or neutral reaction, and the transplant does not change its character. This again speaks in favor of the acid or peculiar chemical reaction that causes this metaplasia.

*Question.* Has Dr. Strauss made any free transplants?

*Answer.* Yes; I have three living dogs operated three months ago in which the same technique was used, except that a free instead of a pedicle transplant was used. My experience with this technique on the common bile duct has produced mostly negative results.

# AMERICAN COLLEGE OF SURGEONS

## HISTORICAL

THE American College of Surgeons was organized at a meeting held in Washington on Monday evening, May 5, 1913. Four hundred and fifty surgeons of the continent of North America came together at the invitation of an Organization Committee which had been appointed by the Clinical Congress of Surgeons of North America at its meeting in November, 1912. This committee consisted of Edward Martin of Philadelphia, Emmet Rixford of San Francisco, John B. Murphy of Chicago, Rudolph Matas of New Orleans, Albert J. Ochsner of Chicago, Charles H. Mayo of Rochester, Minn., Frederic J. Cotton of Boston, George Emerson Brewer of New York, J. M. T. Finney of Baltimore, W. W. Chipman of Montreal, George W. Crile of Cleveland and Franklin H. Martin of Chicago.

The invitations which resulted in this large gathering of surgeons in Washington were extended by the Organization Committee after a carefully prepared campaign in which each large university city on the continent was visited by a member of the committee who met, in person, a group of selected men brought together by a committee of three in each locality, which committee had been authorized by the Organization Committee to extend an invitation to the surgeons in their locality to meet the representative of the Organization Committee. These five hundred men who were invited to the meeting in Washington, four hundred and fifty of whom responded, represented all branches of surgery and surgical specialties.

## ORGANIZATION

At this meeting in Washington, called for the purpose of effecting an organization, the Committee on Organization presented a definite tentative plan, which plan included a call of the meeting, the presentation of by-laws, the presentation of resolutions, and a plan for the completion of the organization by the election of governing bodies and executive officers.

## CALL OF THE MEETING

The men were called together by Edward Martin, Chairman of the Committee, who called for the reading of the Call of the Meeting.

The Call of the Meeting was read by Franklin H. Martin, Secretary of the Committee. This call, which is herein quoted in part, summarizes the work for which, in the opinion of the committee, the American College should stand:

"First. It should formulate a minimum standard of requirements which should be possessed by any authorized graduate in medicine who is allowed to perform, independently, surgical operations in general surgery or any of its specialties.

"Second. It should consider the desirability of listing the names of those men who desire to practice surgery and who come under the authorized requirements.

"Third. It should seek the means of legalizing under national, colonial, state or provincial laws, a distinct degree supplementing the medical degree, which shall be conferred upon physicians possessing the requirements recognized by this law as necessary to be possessed by operating surgeons.

"Fourth. It should seek co-operation with the medical schools of the continent which have the right to confer the degree of M. D. under the present recognized standards, and urge these colleges to confer a supplementary degree on those of its graduates who have, in addition to their medical course, fulfilled the necessary apprenticeship in surgical hospitals, operative laboratories, and actual operative surgery.

"Fifth. It should authorize and popularize the use of this title by men upon whom it is conferred, and its use should especially be urged in all directories of physicians in order that the laity as well as medical men may distinguish between the men who have been authorized to practice surgery, and those who have not."

The founders' organization was completed by the election of a chairman and a secretary, and the authorization of an order of business. The meeting then proceeded to complete the organization by adopting by-laws, rules and regulations and electing governors, regents and officers.

## BY-LAWS

I. NAME. The name of the corporation shall be the American College of Surgeons.

II. OBJECT. The object of the College shall be to elevate the standard of surgery, to establish a standard of competency and of character for practitioners of surgery, to provide a method of granting fellowships in the organization, and to educate the public and the profession to understand that the practice of surgery calls for special training, and that the surgeon elected to fellowship in this College has had such training and is properly qualified to practice surgery.

III. THE COLLEGE. 1. The College shall consist of all members of the corporation. Such members are to be designated as Fellows. The College shall vest the general management of the corporation in a Board of Governors. The Board of Governors shall in turn vest the details of the management in a board of trustees to be known as the Board of Regents.

2. The College shall hold an annual meeting on the day and at the place selected for the annual meeting of the Board of Governors.

IV. BOARD OF GOVERNORS. 1. The original Board of Governors shall consist of the surgeons invited by the Organization Committee to serve as founders of the College, who have qualified as Fellows. The members of this first Board of Governors shall also be known as the Founders of the American College of Surgeons.

2. The original Board of Governors shall be divided by lot into three classes to serve one, two, and three years respectively. At the annual meeting in 1914, and at the annual meeting in each year thereafter, the Fellows of the College shall elect (in a manner to be determined by the Board of Regents) fifty surgeons from among the Fellows of the College to membership on the Board of Governors, each to serve for a term of three years; thirty of these members are to be elected from a list of nominations, consisting of three members each, nominated by the following fifteen surgical associations and societies of North America, and one each from the United States Army and from the United States Navy.

1. American Surgical Association.
2. Surgical Section of the American Medical Association.
3. Section on Obstetrics, Gynecology, and Abdominal Surgery of the American Medical Association.
4. General Surgical Division of the Clinical Congress of Surgeons of North America.
5. Division of Surgical Specialties of the Clinical Congress of Surgeons of North America.
6. American Gynecological Society.
7. Southern Surgical and Gynecological Association.
8. Western Surgical Association.
9. Section on Surgery of the Canadian Medical Association.
10. American Association of Obstetricians and Gynecologists.
11. American Orthopedic Association.
12. American Association of Genito-Urinary Surgeons.
13. American Laryngological Association.
14. American Ophthalmological Society.
15. American Otological Society.

Twenty members shall be elected at large to represent surgeons of North America not affiliated with the above societies or associations. In case of failure of any of the above named organizations to make its quota of nominations, or in case of duplication of nominees, the Board of Regents shall nominate members from among the Fellows at large for the vacancies so caused in the list of nominees. The Board of Regents shall in the same manner fill all vacancies in the current membership of the Board of Governors due to death, resignation, or other causes.

3. The Board of Governors shall at its first meeting elect from its own membership twelve who shall be members of the Board of Regents; this group shall be divided into three classes of four members each, whose terms of office shall expire in one, two, and three years respectively. As the term of service in each class expires, their successors shall be elected, each for a term of three years. Not more than three of each class shall be selected from one country. In the event of death or resignation of any member of the Board of Regents, his successor shall be elected at the next regular or special meeting of the Board of Governors, but the Board of Regents may appoint a member of the Board of Governors to serve as Regent until this election takes place.

4. The Board of Governors shall meet in executive session annually for the transaction of business, which business shall include the election of members of the Board of Regents and the election of officers as provided in Article IV, Section 3, and other routine business which may be brought before it by the corporation or the Board of Regents. Such meetings shall be called by the Secretary at the direction of the Board of Regents. Special meetings of the Board of Governors may be called by the Secretary at any other time at the request of the Board of Regents. Members of the Board of Governors shall be expected to attend other formal meetings and convocations called by the Board of Regents for the purpose of conferring fellowships and the transaction of other business.

5. Fifty members of the Board of Governors shall constitute a quorum for the transaction of business.

V. OFFICERS. The officers of the College shall be a President, a First Vice-President, a Second Vice-President, a Treasurer, and a General Secretary. Such officers shall be elected by the Board of Governors from among the Fellows of the College, each for a term of one year, and shall serve until their successors are elected. The President, the General Secretary, and the Treasurer shall upon their election to office become members of the Board of Regents.

(*a*) The President shall preside at all regular and special meetings of the College and of the Board of Governors and at all convocations for the conferring of fellowships.

(*b*) The Vice-President shall preside at all meetings of the College in the absence of the President, and in the event of the death or resignation of the President, shall assume the duties of that officer.

(*c*) The General Secretary shall keep all records of the Corporation, of the Board of Governors and of the Board of Regents, shall mail to the proper addresses all notices of regular and special meetings of the College, of the Board of Governors and of the Board of Regents and shall have a general supervision of the business affairs of the Corporation under the direction of the Board of Regents.

(*d*) The Treasurer shall receive all funds of the College and disburse the same on checks, signed by him and countersigned by the Secretary. He shall make a report in writing to the Board of

Regents at each meeting of that Board of the moneys received and expended, and shall furnish a detailed statement of the financial condition of the College at each annual meeting of the Board of Regents. The Treasurer shall furnish a bond to the Board of Regents for the faithful performance of his trust.

(*e*) In the event of the death or resignation of the General Secretary or Treasurer, the Board of Regents shall elect his successor from among the members of the Board of Governors to serve until the next annual meeting of the Board of Governors and until such time as his successor is elected and qualified.

VI. BOARD OF REGENTS. 1. The Board of Regents shall consist of the President of the Corporation, the General Secretary of the Corporation, the Treasurer of the Corporation, and twelve members of the Board of Governors elected as hereinbefore provided.

2. The duties of the Board of Regents shall be those ordinarily performed by a board of trustees, namely: the transaction of all detail business devolving upon the Board of Governors in carrying out the object of the organization; the regulation and conserving of its property interests; the creating, appointing, and directing of all standing committees; the election of Fellows to the College; the calling of all meetings of the Corporation not already provided for; the arrangement of convocations or other meetings for the conferring of Fellowships; the transaction of all business not otherwise provided for, that may pertain to the Organization.

3. The officers of the Board of Regents shall be a Chairman and a Secretary.

(*a*) The Chairman of the Board of Regents shall be elected from among the members of the Board of Regents for a term of one year and shall preside at all meetings of the Board. In the event of his death or resignation, the office shall be filled by election at the next meeting of the Board.

(*b*) The General Secretary of the Corporation shall be the Secretary of the Board of Regents.

4. The Board of Regents shall elect the following committees: 1, Credentials; 2, Standardization of Fellowships; 3, Legislation; 4, Graduate schools and hospitals.

(*a*) Each standing committee shall consist of five members, the Chairman of which shall be a member of the Board of Regents. The other four members may be selected from the Board of Governors or from the body of Fellows of the College.

(*b*) Other standing committees may be elected from time to time by the Board of Regents.

5. Eight members of the Board of Regents shall constitute a quorum for the transaction of business.

6. Regular meetings of the Board of Regents shall occur once in six months on the call of the Secretary. Special meetings may be convened at any time by the Secretary, or on a request to him made in writing and signed by thirty members of the Board of Governors, or eight members of the Board of Regents.

VII. FELLOWS.. 1. The Fellows of the College shall be graduates in medicine who are licensed to practice medicine in their respective states and provinces, or medical officers of the federal services, who have made an application for fellowship (such application being endorsed by three Fellows of the College, one of whom shall be a member of the Board of Governors) who meet the qualification requirements that shall from time to time be established by the Board of Regents, and who shall be elected to fellowship by the Board of Regents on recommendation of the Committee on Credentials and who shall have signed the roll.

2. Each individual elected to Fellowship in the College shall be designated as a Fellow of the American College of Surgeons and shall be authorized and encouraged to use the letters F. A. C. S. after his name on professional cards, in professional directories, and in articles published in surgical literature.

VIII. FEES. An initial fee of twenty-five dollars shall be required of each member of the College on his election to Fellowship by the Board of Regents. A fee of five dollars shall be required each year for five years. A payment of fifty dollars at entrance shall relieve the member of further payments.

IX. PUBLICATIONS. The Board of Regents shall issue each year a directory containing the names and addresses of the Fellows of the American College of Surgeons arranged by states, provinces, and colonies.

X. Any member of the College may be expelled for conduct which in the opinion of the Board of Regents is derogatory to the dignity of the College or inconsistent with its purposes. Such expulsion must be voted by a majority vote of the whole Board of Regents at any meeting, to which meeting the member against whom charges are made shall be invited to be present, and may appear or may be represented, in a manner to be determined by the Board of Regents.

XI. These by-laws may be amended by a majority vote of those present at any regular or special meeting of the Board of Governors, or at a meeting called for the purpose on request made in writing by a hundred members of the Corporation, provided that such proposed amendments are included in the call of the meeting at which such action is contemplated.

### OFFICERS

President, J. M. T. Finney, Maryland; First Vice-President, W. W. Chipman, Quebec; Second Vice-President, Rudolph Matas, Louisiana; Treasurer, Albert J. Ochsner, Illinois; General Secretary, Franklin H. Martin, Illinois.

### BOARD OF REGENTS

J. M. T. Finney, Maryland; Albert J. Ochsner, Illinois; Franklin H. Martin, Illinois; George E. Brewer, New York; George E. Armstrong, Quebec; John B. Murphy, Illinois; Edward Martin, Pennsylvania; Frederic J. Cotton, Massachusetts; Herbert A. Bruce, Ontario; Charles F. Stokes, Washington, D. C.; William D. Haggard, Tennessee;

George W. Crile, Ohio; Robert E. McKechnie, British Columbia; Charles H. Mayo, Minnesota; Harry M. Sherman, California.

### SELECTION OF FELLOWS

It was determined by the organization to admit surgeons to Fellowship under two groupings: First, the charter members, consisting of surgeons of distinction and ability who have been in the practice of medicine not less than eight years and who, in the opinion of the Board of Regents, should be entitled to Fellowship without the formality of an examination; second, those who should be required to submit to an examination or other test of qualification required by the Board of Regents. It was decided to limit the time of admission of the first group of charter members to November 1, 1914, and to postpone the admission of Fellows by examination until the Board of Regents had formulated detailed plans of a satisfactory nature for admission by this method, not earlier than November 1, 1913.

### APPLICATION FOR MEMBERSHIP.

The Board of Regents at its earlier meetings announced that it would be the spirit of the association to open the fellowship to all competitors in surgery without favor. The Board of Regents is anxious to have every surgeon on the continent who can fulfill the membership requirements become a Fellow of the organization. The General Secretary is therefore instructed to send application blanks to any legally qualified practitioner of medicine on the American continent who may signify his desire to become a member.

### METHOD OF SELECTING FELLOWS

The by-laws specifically state that the Fellows of the College "shall be graduates in medicine who are legalized to practice medicine in their respective states or provinces and who meet the qualification requirements that shall from time to time be established by the Board of Regents."

The application blanks are uniform and each applicant for membership is required to file an application blank filled out in detail and signed. The blank contains the following questions and specifications:

Name. Address. Place and date of birth.
What school, academy, college or university did you attend? Date of graduation? Degrees?
What medical college or colleges did you attend? Date of graduation? Degrees?
In what hospitals have you been an interne, resident or assistant? From ——— to ———?
In what hospitals have you been a staff member and in what capacity?
In what teaching capacity have you been active?
What other appointments have you had?
What post-graduate studies have you pursued in America and where?
What post-graduate studies have you pursued abroad and where?
What official positions have you held?
How many years in special practice and where?
What department of special practice?
What percentage of your work is surgical?
What research or experimental work have you done?
Of what medical societies are you a member?
Give the names of five prominent surgeons as references, at least three of whom are from your own state.
Give the names of books and contributions to medical and surgical literature of which you are the author, with date and place of publication.

Signed ———

Date ———

The application papers contain a separate declaration against the practice of fee-splitting. This is in the nature of a personal pledge and each applicant is required to attach his signature to it and file it with his papers.

### REFERENCE BLANK

While the by-laws require that an applicant give three endorsers, the Committee on Credentials now recommend that five names be given, three of which should be from the applicant's own state. The reference blank contains the following questions and answers:

Name. Address. College and date of graduation.
1. How long have you known the applicant?
2. What is his surgical standing in the profession?
3. What is his experience as a surgeon?
4. How extensively does he specialize?
5. What special training in surgery has he had?
6. What is his moral standing in his community?
7. What is his ethical standing?
8. Do you believe he will carry out in practice the spirit of the enclosed declaration?
9. Do you believe from your knowledge of the applicant's life that we can accept in good faith his fulfillment of the principles involved in the enclosed declaration if signed by him?
10. Do you believe he is in every way qualified for Fellowship in the American College of Surgeons?
11. Remarks.

### COMMITTEES ON CREDENTIALS

The Board of Regents has authorized Committees on Credentials consisting of the Central Committee, which reports directly to the Board of Regents, and State and Provincial Committees, which report to the Central Committee on Credentials.

The Central Committee on Credentials holds its meeting in the office of the College, where the members can have access to all papers and correspondence filed in connection with each candidate.

The State and Provincial Committees, each consisting of from five to seven members, are located in nearly every state in the United States and in four divisions of Canada.

### DUTIES OF COMMITTEES ON CREDENTIALS

The name of each applicant for fellowship, together with the names of his references, is sent by the Central Committee on Credentials to the State or Provincial Committee which has jurisdiction over the territory in which the candidate resides,

and this local committee, after consideration, makes its recommendations to the Central Committee.

When an applicant's papers are complete, including a report from each of the references given and from the State Committee on Credentials, the Central Committee on Credentials takes up the application for final consideration and recommendation.

When the candidate has successfully passed the final scrutiny of the Central Committee on Credentials, he is recommended to the Board of Regents for election to Fellowship. If, on the other hand, the candidate's papers are found defective or his qualifications are considered below the standard for fellowship required by the College, the Committee on Credentials notifies the candidate by the following form letter:

Dear Doctor: —

Your application to the American College of Surgeons has been considered by our committee on several occasions, but we regret to say that the data submitted are defective to the extent indicated on the accompanying card.

So far, our committee has had submitted to it over 20,000 pages of material for consideration in connection with the various applications for membership, all of which had to be carefully read, and you can readily see that in order to perform our duties thoroughly, we have been compelled to adhere to rules which might seem unreasonably strict, were we not compelled to do this work in an entirely impersonal manner.

We have consequently decided to send this form letter to all applicants whose applications it has not been possible to send to the Board of Regents with our recommendation for election of the applicant. This action is frequently due to the fact that the surgeons given for reference have neglected to send in reports upon which judgment could properly be based.

Accompanying the above letter are two cards: Card "A" indicating the defect in the credentials or documents of the applicant and Card "B" indicating the remedy proposed. The status of the applicant's papers are shown by the underscored lines.

### APPLICATIONS FOR FELLOWSHIP

Over two thousand applications for fellowship in the College had been filed up to November 1, 1913, fully one-half of which were voluntary applications. Of this number the Committee on Credentials recommended to the Board of Regents 1057 for fellowship at the first convocation. A large number of the applications still on file will undoubtedly be found to represent successful candidates, when they have been considered by the Committee.

### THE FIRST CONVOCATION

The first convocation of the American College of Surgeons occurred in the Gold Room of the Congress Hotel, Chicago, on the evening of November 13, 1913.

The prospective Fellows were invited to sign the roll of membership at this place during the day. The roll was furnished in loose leaf form, and a corps of assistants presided over the formality of signing in a manner to make it possible for a large number to be accommodated in a short space of time. Each page of the roll was headed by a pledge or contract and to this the Fellow appended his signature and address.

### EELLOWSHIP PLEDGE

Recognizing that the American College of Surgeons seeks to develop, exemplify and enforce the highest traditions of our calling, I hereby pledge myself, as a condition of fellowship in the College, to live in strict accordance with all its principles, declarations, and regulations. In particular I pledge myself to pursue the practice of surgery with thorough self-restraint and to place the welfare of my patients above all else; to advance constantly in knowledge by the study of surgical literature, the instruction of eminent teachers, interchange of opinion among associates, and attendance on the important societies and clinics; to regard scrupulously the interests of my professional brothers and seek their counsel when in doubt of my own judgment; to render willing help to my colleagues and to give freely my services to the needy. Moreover, I pledge myself, so far as I am able, to avoid the sins of selfishness; to shun unwarranted publicity, dishonest money-seeking, and commercialism as disgraceful to our profession; to refuse utterly all secret money trades with consultants and practitioners; to teach the patient his financial duty to the physician and to urge the practitioner to obtain his reward from the patient openly; to make my fees commensurate with the service rendered and with the patient's rights; and to avoid discrediting my associates by taking unwarranted compensation. Finally I pledge myself to co-operate in advancing and extending, by every lawful means within my power, the influence of the American College of Surgeons.

### ACADEMIC ROBE

After careful consideration of the matter and in view of the fact that important convocations at which new Fellowships will be conferred will occur each year, the Board of Regents adopted a distinct fellowship gown which, in their opinion, will add dignity, uniformity, and academic distinction to the formal gatherings of the College.

The gown adopted consists of a body of navy blue mohair. A scarlet velvet facing five inches wide extends around the neck and down each side of the front. The cap is of the same material as the gown, with a scarlet tassel.

### PROGRAM

8:00 Fellows and guests assembled.
8:15 Governors assembled.
8:25 Regents assembled with honorary guests.
Invocation by the Rev. J. G. K. McClure.
Presentation of the Roll of Fellows and Honorary Fellows by the Secretary.
Conferring of Fellowships by the President.
Introduction of Honorary Fellows individually by the Regents and conferring of Fellowships by the President.

### CONFERRING OF FELLOWSHIPS

Sir Rickman J. Godlee of London was introduced by Regent W. W. Chipman. Before conferring the degree, the President, Dr. J. M. T. Finney, received the candidate and said:

"Sir Rickman J. Godlee, student, versatile author, distinguished surgeon, worthy member of a family whose name is known and honored wherever antiseptic surgery is practiced, President of the Royal College of Surgeons of England, the highest honor within the gift of his professional associates at home. His presence here is a renewed evidence of the mutual high regard and esteem held for each other by the two great English-speaking nations."

The President then conferred upon Sir Rickman J. Godlee an honorary fellowship in the American College of Surgeons.

William W. Keen of Philadelphia was introduced by Regent George W. Crile. Before conferring the degree, the President received the candidate and said:

"William Williams Keen, nestor of American surgery after a professional life covering fifty-two years. As a leader of the Jefferson School of Philadelphia, he links us with the great professional names of the nineteenth century. Army surgeon, teacher, operator, writer, publicist, traveler, patron of art, promoter of the best in higher education, public-spirited citizen; recipient of the greatest gifts in American medicine, Honorary Fellow of the Royal College of Surgeons of England and of Edinburgh, he is honored throughout Europe. Wherever good surgery is regarded, there he is quoted."

The President then conferred upon Dr. William W. Keen an honorary fellowship in the American College of Surgeons.

William Stewart Halsted of Baltimore was introduced by Regent Charles F. Stokes. Before conferring the degree, the President received the candidate and said:

"William Stewart Halsted, surgeon, teacher, investigator, honored at home and abroad; contributor to the progress of science. One of the four distinguished founders of the Johns Hopkins School of Medicine. His gifts to surgical technique, to numerous valuable operations now the standard, and to many great advances in surgical physiology and pathology, have brought to him international renown. Honorary Fellow of the Royal College of Surgeons of England and of Edinburgh — with undiminished vigor he still pursues his valuable career."

Following this, honorary degrees were conferred *in absentia* (candidates being unable to attend because of illness) upon J. Collins Warren of Boston and Robert F. Weir of New York.

### FELLOWSHIP ADDRESS

Sir Rickman J. Godlee, President of the Royal College of Surgeons of England, was introduced by the President, J. M. T. Finney, and upon rising, was received with prolonged applause, the entire audience rising to greet him. Before reading his formal address, he presented a greeting to the American College of Surgeons, in the form of an illuminated parchment, from the Royal College of Surgeons of England.

### GREETING FROM THE ROYAL COLLEGE OF SURGEONS

We, the Council of the Royal College of Surgeons of England, have heard with much interest of the approaching inauguration of the American College of Surgeons. We hereby convey to it our hearty good wishes, and express the hope that it may have a successful career and fill a position beneficial alike to the Profession and to the Community.

We cannot forget the important advances in the Science and Art of Surgery achieved by many distinguished Surgeons in the Continent of America during the past, and are proud to have enrolled upon our list of Honorary Fellows the names of some of the most active workers in these fields at the present day.

In accepting the invitation for our President to take a part in the opening Ceremony, we desire to show that we appreciate the intention of the American College to strengthen the bonds that already unite the Medical Profession amongst the English-speaking peoples. It is a sentiment which always meets with a cordial response in this Country, and it is one which this College will endeavor to support by all the means in its power.

In witness whereof we have caused the Common Seal of the College to be hereunto affixed this 9th day of October, 1913.

President: RICKMAN J. GODLEE.
Vice-presidents: G. H. MAKINS.
[SEAL] FREDERIC EVE.

Sir Rickman J. Godlee then delivered the formal address to the American College. This address will be printed in full and distributed to the Fellows of the American College of Surgeons and to members of the profession.

### ABSTRACT OF ADDRESS

In the first place it was pointed out that it is difficult for anyone, and especially for people living in America, to appreciate the conditions in England at the beginning of the fourteenth century. This was near the end of the middle or dark ages. The military spirit prevailed, science was under a dark cloud, and medicine was not in advance of other sciences. Surgery was not so much respected as medicine. Surgeons indeed were classed with barbers and for the most part belonged to the Barbers' Guild which was formed in 1308. It included those who practiced minor surgery, but the better classes of surgeons held aloof and formed themselves into the Guild of Surgeons.

Reference was then made to the origin of the guilds in the city of London. They were associations or fraternities of artisans for the supervision of the crafts and for regulating the hours of labor. They became important bodies, and elected the Lord Mayor and Corporation.

More than two hundred years later, namely in 1542, the Barbers' Company and the Guild of Sur-

geons united and were incorporated as the Company of Barber-Surgeons. This company existed another two hundred years, namely until 1745. They exercised extensive control over the surgeons of the country. They gave licenses to practice; and sometimes deprived surgeons of their licenses; they supervised the public dissections, which were the only form of anatomical study recognized by law; they appointed lecturers in surgery; possessed a censorship over books, and had other very important duties. The two bodies were, however, incompatible and in 1745 the Surgeons' Company was separated from that of the Barber-Surgeons. In 1800 they were established as the Royal College of Surgeons in London, and in 1843 the name was again changed, by a charter of Queen Victoria, to that of the Royal College of Surgeons of England.

The College of Surgeons had their first quarters in the Old Bailey, and later on moved to their present house in Lincoln's Inn Fields. The ancient titles of Master, Governors, and Court of Associates were changed to those of President, Vice President, and Council. The corporation consisted of the members. In 1843 a new class of members who were called Fellows was formed, from and by whom the Council henceforth was to be chosen, instead of being elected by the Council themselves as had been the case up to this date. The first Fellows were chosen from the members, being elected by the Council chiefly from the surgeons, assistant surgeons, and lecturers of the metropolitan hospitals, and they also included representatives of the naval, military, and Indian forces. But since that time the ordinary portal for admission to the Fellowship has been an examination — or rather, two examinations — which constitute a formidable and searching test of ability. The class of Members now numbers over 17,000; the Fellows number 1589.

Reference was then made to the new American College of Surgeons, and to the methods of recruiting its Fellowship. After describing in some detail the examinations above referred to, a contrast was drawn between the English and American Colleges. Some of the other functions of the English College were passed in review, especially that of the discipline which it can exercise over its Fellows and members. In connection with the examination for the diploma of membership, the question of a uniform system of admission to the medical profession was discussed, and in this connection it was pointed out how in England attempts are being made to secure this result.

In conclusion the relations of the Royal Colleges of Physicians and Surgeons in London was referred to, and the opinion was expressed that as surgery advances, the tendency will be for these two great departments of the profession to be drawn more closely together.

### PRESIDENTIAL ADDRESS

President J. M. T. Finney then delivered the presidential address to the Fellows of the College. This address will be printed in full and distributed to the Fellows of the American College of Surgeons and to members of the profession. His remarks in brief were as follows:

"The highest development of the greatest efficiency along all lines of public service relating in any way to our profession." With this as the keynote, the American College of Surgeons was launched by Dr. Finney on what is thought by all concerned to be a career of usefulness for the public at large. "The history of surgery in the United States and Canada," said Dr. Finney, "is opened to a new page. When at some future time the historian comes to write on that page the record of events that have led up to this meeting, he will there record the taking of another step in the progress of medicine in general and of surgery in particular in Canada and the United States. What is consummated here tonight is destined to produce a deep and lasting impression upon medical progress not alone in those countries but indirectly the world over.

"The present and future welfare of the profession has been for a long time uppermost in the minds and very close to the hearts of many of us. We have pictured to ourselves in this connection a profession ennobled by men actuated solely by their desire to devote their time and their talents to the relief of suffering humanity, willing, yes, glad at any time, if need be, to lay down their own lives for those of their fellow-men; whose membership should embrace only men of singleness of purpose, unselfish, high-minded, zealous in their efforts to wrest from nature the keys to her many mysteries; men who unconsciously, perhaps, in character and conduct, reflect in varying degree the life and spirit of the Great Physician; a profession free from taint of commercialism or graft, in which there shall be no room for the base, the unscrupulous, the ignorant, or unskilled; in which the test for membership has to do only with character and attainment.

"Our hopes and dreams, so long dim, shadowy, and unreal, are about, in part at least, to assume definite and concrete form. We are assembled here this evening to witness, indeed to assist at, the birth of a new agency for good, both to the public and to the profession; to bid Godspeed to this lusty infant, the American College of Surgeons, the offspring of a fruitful union between a deep-rooted and praiseworthy desire within the profession to elevate its standard of ethics and efficiency, and a lively sense of the urgent and long-felt need of its accomplishment.

"The aim of this organization and the reason for its existence lies in its disinterested and unselfish efforts to elevate the standards of the profession, moral as well as intellectual, to foster research, to educate the public up to the idea that there is a difference between the honest, conscientious, well-trained surgeon and the purely commercial operator, the charlatan and the quack; furthermore, that the term "surgeon" means something more than a

suave manner, a glib tongue, a private hospital, a press-agent, and the all too easily acquired diploma, with its accompanying title of 'doctor.' The standardization of surgery is absolutely essential to guard the public against such as these, as well as to preserve the honor of the guild itself. So far as the public is concerned, it is necessary to protect it from the wolves in sheep's clothing, from those who would prostitute their high office for the purpose of gain, from the ignorant and the untrained, from those who by reason of the lack of surgical judgment and skill are incompetent. The American College of Surgeons has been called into being as an active, vigorous, virile protest upon the part of the profession itself against this unhappy state of affairs.

"The public and professional minds should therefore be at once thoroughly disabused of any wrong impression that the College is to be run by any one man or set of men, or by or in association with any pre-existing organization for his or their personal gain or aggrandizement. The American College of Surgeons is no surgical trust, no close corporation for the benefit of the few. It plays no part whatever in medical politics, it does not interest itself in the advancement of any corporation or group of individuals, nor in any special school or cult of medicine. It stands only for the good of humanity and the uplift of professional standards of morality and education."

Adjournment was followed by a reception of the Fellows and guests by the officers of the College and Sir Rickman J. Godlee.

### PERMANENT HOME OF THE COLLEGE

At the meeting of the Board of Regents held November 13, 1913, Franklin H. Martin asked the privilege of discussing the selection of a permanent home for the American College of Surgeons. Dr. Martin said: "It is the judgment of your Secretary that the permanent home of the American College of Surgeons should be located in a city other than Chicago. Chicago is already the home of one of the strongest medical organizations in the country, and on the grounds of equity alone, another city should have the honor of housing this new and powerful organization — the American College of Surgeons. I, therefore, move that a committee of five be appointed by the President which should have for its object the selection of a permanent home for the American College of Surgeons. I would include in the motion that this permanent home be ready, if possible, for occupancy at the annual meeting in November, 1914, at the end of our first fiscal year." The motion was seconded by Dr. John B. Murphy.

After considerable discussion, Dr. J. M. T. Finney made a statement in which he said Dr. Martin had presented his views on the subject to him in a personal interview, and that he, Dr. Finney, was convinced in the face of all the facts, that it would be advisable in his opinion to adopt Dr. Martin's resolution. A motion was then passed, all members of the Board of Regents present voting in the affirmative.

The President appointed the following committee on permanent home for the American College of Surgeons: C. F. Stokes, Chairman, F. J. Cotton, H. A. Bruce, G. W. Crile, G. E. Brewer, H. M. Sherman.

### FUTURE CONVOCATIONS

The next convocation for the admission of Fellows will be held in one of the eastern cities on Monday evening of the week of the meeting of the American Medical Association. The third convocation and the annual meeting will convene in November, 1914, the date and place to be determined by the Board of Regents.

# FELLOWS OF THE AMERICAN COLLEGE OF SURGEONS

The following list contains the names of the surgeons upon whom fellowships in the American College of Surgeons were conferred at the first convocation on November 13, 1913. More than a thousand applications are in the hands of the Committee on Credentials. These will be considered as rapidly as the documents are completed. Other applications for this Charter Member group will be received until November 1, 1914. Successful candidates will receive their fellowships at convocations to be held in June and 1, November, 1914.

## *HONORARY FELLOWS*

| | |
|---|---|
| Sir Rickman J. Godlee | London, England |
| William Williams Keen | Philadelphia |
| William S. Halsted | Baltimore |
| J. Collins Warren | Boston |
| Robert F. Weir | New York |

## UNITED STATES OF AMERICA

### *ALABAMA*

| | |
|---|---|
| James Norment Baker | Montgomery |
| Herbert Phalon Cole | Mobile |
| K. W. Constantine | Birmingham |
| John D. S. Davis | Birmingham |
| Francis G. DuBose | Selma |
| J. N. Furniss | Selma |
| James A. Goggans | Alexander City |
| W. T. Henderson | Mobile |
| L. L. Hill | Montgomery |
| Robert Somerville Hill | Montgomery |
| William R. Jackson | Mobile |
| W. M. Jordan | Birmingham |
| S. Kirkpatrick | Selma |
| James Monro Mason | Birmingham |
| William McDowell Mastin | Mobile |
| C. A. Thigpen | Montgomery |
| Isaac Lafayette Watkins | Montgomery |

### *ARIZONA*

| | |
|---|---|
| John Elmer Bacon | Miami |
| E. Payne Palmer | Phoenix |

### *ARKANSAS*

| | |
|---|---|
| St. Cloud Cooper | Fort Smith |
| R. C. Dorr | Batesville |
| William V. Laws | Hot Springs |

### *CALIFORNIA*

| | |
|---|---|
| Frank C. Ainley | Los Angeles |
| Eliot Alden | Los Angeles |
| Thomas E. Bailly | San Francisco |
| J. Henry Barbat | San Francisco |
| J. Mackenzie Brown | Los Angeles |
| Rexwald Brown | Santa Barbara |
| Guy Cochran | Los Angeles |
| Edward T. Dillon | Los Angeles |
| William A. Edwards | Los Angeles |
| H. Bert Ellis | Los Angeles |
| Ernest W. Fleming | Los Angeles |
| Oliver D. Hamlin | Oakland |
| Henry W. Howard | Los Angeles |
| Thomas W. Huntington | San Francisco |
| Charles G. Levison | San Francisco |
| Andrew Stewart Lobingier | Los Angeles |
| Charles D. Lockwood | Pasadena |
| Granville MacGowan | Los Angeles |
| A. L. Macleish | Los Angeles |
| Frank W. Miller | Los Angeles |
| E. C. Moore | Los Angeles |
| M. L. Moore | Los Angeles |
| Lewis B. Morton | Los Angeles |
| Henry P. Newman | San Diego |
| Walter B. Power | Redlands |
| W. W. Richardson | Los Angeles |
| Leon Joseph Roth | Los Angeles |
| Henry Howard Sherk | Pasadena |
| Harry M. Sherman | San Francisco |
| Harold D. Sidebotham | Santa Barbara |
| Rea Smith | Los Angeles |
| G. B. Somers | San Francisco |
| Stanley Stillman | San Francisco |
| F. Dudley Tait | San Francisco |
| Wallace Irving Terry | San Francisco |
| I. W. Thorne | San Francisco |
| C. Van Zwaluwenburg | Riverside |
| W. Francis B. Wakefield | San Francisco |
| James Thomas Watkins | San Francisco |
| Alanson Weeks | San Francisco |
| William P. Williamson | San Diego |
| O. O. Witherbee | Los Angeles |

### *COLORADO*

| | |
|---|---|
| Melville Black | Denver |
| Leonard Freeman | Denver |
| William W. Grant | Denver |
| Thomas J. Gallaher | Denver |
| Edward Jackson | Denver |
| Walter A. Jayne | Denver |
| Maurice Kahn | Leadville |
| Lorenzo B. Lockard | Denver |
| Oliver Lyons | Denver |
| Francis H. McNaught | Denver |
| George B. Packard | Denver |
| Charles A. Powers | Denver |
| Horace Greeley Wetherhill | Denver |

### *CONNECTICUT*

| | |
|---|---|
| Arthur N. Alling | New Haven |
| George M. Burroughs | Danielson |
| W. H. Carmalt | New Haven |
| Carl E. Munger | Waterbury |
| Oliver Cotton Smith | Hartford |

### *DISTRICT OF COLUMBIA*

| | |
|---|---|
| Edward A. Balloch | Washington |
| Rupert Blue | Washington |
| William Cline Bordon | Washington |
| J. Wesley Bovée | Washington |
| Joseph H. Bryan | Washington |
| W. P. Carr | Washington |
| Virginius Dabney | Washington |
| William G. Erving | Washington |
| Henry D. Fry | Washington |
| Francis Randall Hagner | Washington |
| Joseph Taber Johnson | Washington |
| Robert S. Lamb | Washington |
| H. W. Lawson | Washington |
| L. C. Lehr | Washington |
| Ernest Pendelton Magruder | Washington |
| G. Brown Miller | Washington |
| John F. Moran | Washington |
| Luther Halsey Reichelderfer | Washington |
| Charles W. Richardson | Washington |
| J. J. Richardson | Washington |
| Stephen O. Richey | Washington |
| Aurelius Rives Shands | Washington |
| William F. M. Sowers | Washington |
| Raymond Spear | Washington |
| Albert L. Stavely | Washington |
| Charles Francis Stokes | Washington |
| Isaac S. Stone | Washington |
| J. Ford Thompson | Washington |
| George H. Torney | Washington |
| George Tully Vaughan | Washington |
| John R. Wellington | Washington |
| Charles S. White | Washington |
| William Holland Wilmer | Washington |

### *FLORIDA*

| | |
|---|---|
| Norman M. Heggie | Jacksonville |
| Gerry R. Holden | Jacksonville |
| Carey Pegram Rogers | Jacksonville |
| Raymond C. Turck | Jacksonville |

### *GEORGIA*

| | |
|---|---|
| William E. Campbell | Atlanta |
| F. Phinizy Calhoun | Atlanta |
| William Simpson Elkin | Atlanta |
| W. S. Goldsmith | Atlanta |
| Edward Groves Jones | Atlanta |
| H. H. Martin | Savannah |
| Floyd Wilcox McRae | Atlanta |
| Wm. Perrin Nicholson | Atlanta |
| George Henry Noble | Atlanta |

### *IDAHO*

| | |
|---|---|
| W. H. Carrithers | Moscow |
| W. F. Howard | Pocatello |
| C. W. Shaff | Lewiston |

### *ILLINOIS*

| | |
|---|---|
| Frank Allport | Chicago |
| E. Wyllys Andrews | Chicago |
| Frank T. Andrews | Chicago |
| Charles S. Bacon | Chicago |
| Joseph Barnes Bacon | Macomb |
| Walter S. Barnes | Chicago |
| Charles H. Beard | Chicago |
| Carl Beck | Chicago |
| Emil G. Beck | Chicago |
| Joseph C. Beck | Chicago |
| William T. Belfield | Chicago |
| Edward M. Bench | Galena |
| Frederic A. Besley | Chicago |
| Arthur Dean Bevan | Chicago |
| Carl E. Black | Jacksonville |
| Wallace Blanchard | Chicago |
| George W. Boot | Evanston |
| Albert I. Bouffleur | Chicago |
| F. E. Brawley | Chicago |
| Truman W. Brophy | Chicago |
| Coleman Graves Buford | Chicago |
| James Burry | Chicago |
| Henry T. Byford | Chicago |
| William E. Casselberry | Chicago |
| Howard R. Chislett | Chicago |
| Robert J. Christie | Quincy |
| William R. Cubbins | Chicago |
| Carey Culbertson | Chicago |
| Arthur H. Curtis | Chicago |
| W. C. Danforth | Evanston |
| Charles Davison | Chicago |
| Philip Schuyler Doane | Chicago |
| Joseph B. DeLee | Chicago |

| | |
|---|---|
| Oscar Dodd | Chicago |
| Robert Dodds | Chicago |
| E. J. Doering | Chicago |
| W. A. Newman Dorland | Chicago |
| E. C. Dudley | Chicago |
| Frederick G. Dyas | Chicago |
| Daniel N. Eisendrath | Chicago |
| George L. Eyster | Rock Island |
| George F. Fiske | Chicago |
| Ira Frank | Chicago |
| Jacob Frank | Chicago |
| Lester E. Frankenthal | Chicago |
| Emanuel Friend | Chicago |
| William Fuller | Chicago |
| Thomas L. Gilmer | Chicago |
| John Ferdinand Golden | Chicago |
| Albert Goldspohn | Chicago |
| Mark T. Goldstine | Chicago |
| David W. Graham | Chicago |
| George W. Green | Chicago |
| L. A. Greensfelder | Chicago |
| Albert E. Halstead | Chicago |
| Thomas Melville Hardie | Chicago |
| M. L. Harris | Chicago |
| William M. Harsha | Chicago |
| Noble Sproat Heaney | Chicago |
| William Hessert | Chicago |
| Junius C. Hoag | Chicago |
| Rudolph W. Holmes | Chicago |
| E. Fletcher Ingals | Chicago |
| Charles E. Kahlke | Chicago |
| Allen B. Kanavel | Chicago |
| A. Belcham Keyes | Chicago |
| George N. Kreider | Springfield |
| Oscar H. Kraft | Chicago |
| Sylvan Kunz | Chicago |
| Dean Lewis | Chicago |
| William H. G. Logan | Chicago |
| Frank W. Lynch | Chicago |
| John Alexander Lyons | Chicago |
| G. W. Mahoney | Chicago |
| George Paull Marquis | Chicago |
| Franklin H. Martin | Chicago |
| L. L. McArthur | Chicago |
| George Martin McBean | Chicago |
| C. Hugh McKenna | Chicago |
| Frederick Menge | Chicago |
| Frank D. Moore | Chicago |
| Frederick B. Moorehead | Chicago |
| George Morganthau | Chicago |
| John B. Murphy | Chicago |
| W. K. Newcomb | Champaign |
| A. J. Ochsner | Chicago |
| Edward H. Ochsner | Chicago |
| John E. Owens | Chicago |
| Charles E. Paddock | Chicago |
| William R. Parkes | Evanston |
| O. L. Pelton, Sr. | Elgin |
| J. R. Pennington | Chicago |
| J. F. Percy | Galesburg |
| Nelson M. Percy | Chicago |
| D. B. Phemister | Chicago |
| Norval H. Pierce | Chicago |
| S. C. Plummer | Chicago |
| John L. Porter | Chicago |
| H. M. Richter | Chicago |
| Charles M. Robertson | Chicago |
| Cassius Clay Rogers | Chicago |
| Edwin W. Ryerson | Chicago |
| St. Elmo M. Sala | Rock Island |
| C. F. Sanborn | Chicago |
| Louis E. Schmidt | Chicago |
| William E. Schroeder | Chicago |
| William N. Senn | Chicago |
| George E. Shambaugh | Chicago |
| Kellogg Speed | Chicago |
| D. A. K. Steele | Chicago |
| Charles J. Swan | Chicago |
| Thomas J. Watkins | Chicago |
| J. Clarence Webster | Chicago |
| Cassius D. Wescott | Chicago |
| William H. Wilder | Chicago |
| Daniel H. Williams | Chicago |
| Casey A. Wood | Chicago |
| Thomas A. Woodruff | Chicago |
| Gilbert H. Wynekoop | Chicago |

## *INDIANA*

| | |
|---|---|
| Paul J. Barcus | Crawfordsville |
| Charles E. Barnett | Fort Wayne |
| John F. Barnhill | Indianapolis |
| L. D. Brose | Evansville |
| Albert E. Bulson, Jr. | Fort Wayne |
| Edgar Cox | Kokomo |
| Joseph Rilus Eastman | Indianapolis |
| Thomas Barker Eastman | Indianapolis |
| A. M. Hayden | Evansville |
| Norman E. Jobes | Indianapolis |
| S. C. Loring | Plymouth |
| Frank A. Morrison | Indianapolis |
| J. H. Oliver | Indianapolis |
| Hugo Otto Pantzer | Indianapolis |
| Miles F. Porter | Fort Wayne |
| Marcus Ravdin | Evansville |
| Maurice I. Rosenthal | Fort Wayne |
| Charles Stoltz | South Bend |
| George K. Throckmorton | Lafayette |
| Ernest de Wolfe Wales | Indianapolis |
| Edwin Walker | Evansville |
| Leon J. Willien | Terre Haute |
| William N. Wishard | Indianapolis |
| Jonathan P. Worrell | Terre Haute |

### *IOWA*

| | |
|---|---|
| William L. Allen | Davenport |
| William W. Bowen | Fort Dodge |
| David C. Brockman | Ottumwa |
| Albertus J. Burge | Iowa City |
| Frank Wilson Dean | Council Bluffs |
| Lee Wallace Dean | Iowa City |
| G. E. Decker | Davenport |
| David S. Fairchild, Sr. | Clinton |
| David S. Fairchild, Jr. | Clinton |
| Oliver J. Fay | Des Moines |
| J. T. Haller | Davenport |
| J. C. Hancock | Dubuque |
| Gordon F. Harkness | Davenport |
| C. S. James | Centerville |
| Lawrence W. Littig | Davenport |
| Donald Macrae, Jr. | Council Bluffs |
| William W. Pearson | Des Moines |
| Alanson M. Pond | Dubuque |
| C. E. Ruth | Des Moines |
| Arthur Steindler | Des Moines |
| John Nelson Warren | Sioux City |

### *KANSAS*

| | |
|---|---|
| David Walker Basham | Wichita |
| Charles E. Bowers | Wichita |
| John Lillie Evans | Wichita |
| George Morris Gray | Kansas City |
| M. T. Sudler | Rosedale |
| W. S. Sutton | Kansas City |

### *KENTUCKY*

| | |
|---|---|
| Irvin Abell | Louisville |
| Archibald H. Barkley | Lexington |
| David Barrow | Lexington |
| Frank Boyd | Paducah |
| William Cheatham | Louisville |
| Louis Frank | Louisville |
| Henry Horace Grant | Louisville |
| Granville S. Hanes | Louisville |
| George A. Hendon | Louisville |
| John D. Jackson | Danville |
| Arthur T. McCormick | Bowling Green |
| Lewis S. McMurtry | Louisville |
| J. Morrison Ray | Louisville |
| H. G Reynolds | Paducah |
| William Owen Roberts | Louisville |
| August Schachner | Louisville |
| J. Garland Sherrill | Louisville |
| Joseph A. Stucky | Lexington |
| Ap Morgan Vance | Louisville |
| John R. Wathen | Louisville |

### *LOUISIANA*

| | |
|---|---|
| Louis Abramson | Shreveport |
| Carroll W. Allen | New Orleans |
| J. D. Bloom | New Orleans |
| S. M. D. Clark | New Orleans |
| Henry S. Cocram | New Orleans |
| Arthur W. de Roaldes | New Orleans |
| Marcus Feingold | New Orleans |
| Herman B. Gessner | New Orleans |
| William Kohlmann | New Orleans |
| Ernest S. Lewis | New Orleans |
| E. Denegre Martin | New Orleans |
| Rudolph Matas | New Orleans |
| C. Jeff Miller | New Orleans |
| Frederick William Parham | New Orleans |
| W. M. Perkins | New Orleans |
| Espy Milo Williams | Patterson |

### *MAINE*

| | |
|---|---|
| Edville Gerhardt Abbott | Portland |
| William Lewis Cousins | Portland |
| Erastus E. Holt | Portland |
| Alfred Mitchell, Jr. | Portland |

### *MARYLAND*

| | |
|---|---|
| Thomas A. Ashby | Baltimore |
| William S. Baer | Baltimore |
| Bertram M. Bernheim | Baltimore |
| Joseph C. Bloodgood | Baltimore |
| John W. Chambers | Baltimore |
| C. A. Clapp | Baltimore |
| Sydney M. Cone | Baltimore |
| Thomas S. Cullen | Baltimore |
| John Staige Davis | Baltimore |
| S. Griffith Davis, Jr. | Baltimore |
| Samuel T. Earle, Jr. | Baltimore |
| J. M. T. Finney | Baltimore |
| William A. Fisher, Jr. | Baltimore |
| Richard H. Follis | Baltimore |
| Harry Freidenwald | Baltimore |
| Archibald C. Harrison | Baltimore |
| John Mason Hundley | Baltimore |
| Guy LeRoy Hunner | Baltimore |
| Howard A. Kelly | Baltimore |
| Frank Martin | Baltimore |
| Alexius McGlannan | Baltimore |
| William E. Moseley | Baltimore |
| Omar B. Pancoast | Baltimore |
| Walter B. Platt | Baltimore |
| Andrew J. N. Reik | Baltimore |
| Henry O. Reik | Baltimore |
| Wm. Wood Russell | Baltimore |
| Arthur M. Shipley | Baltimore |
| George Walker | Baltimore |
| J. Whitridge Williams | Baltimore |

| | |
|---|---|
| John R. Winslow | Baltimore |
| Randolph Winslow | Baltimore |
| Thomas C. Worthington | Baltimore |
| Hugh Hampton Young | Baltimore |

### *MASSACHUSETTS*

| | |
|---|---|
| Franklin Greene Balch | Boston |
| Clarence J. Blake | Boston |
| John Bapst Blake | Boston |
| John Taylor Bottomley | Boston |
| E. G. Brackett | Boston |
| George W. W. Brewster | Boston |
| Daniel J. Brown | Springfield |
| Alice G. Brant | Boston |
| Hugh Cabot | Boston |
| H. M. Chase | Boston |
| Arthur L. Chute | Boston |
| F. T. Clark | Westfield |
| Farrar Cobb | Boston |
| Ernest Amory Codman | Boston |
| William M. Conant | Boston |
| Frederic J. Cotton | Boston |
| Eugene A. Crockett | Boston |
| J. H. Cunningham, Jr. | Boston |
| Emma V. P. B. Culbertson | Boston |
| Harvey Cushing | Boston |
| Hayward Warren Cushing | Boston |
| Francis H. Davenport | Boston |
| Lincoln Davis | Boston |
| Robert L. DeNormandie | Boston |
| George S. Derby | Boston |
| Florence W. Duckering | Boston |
| Charles Edwin Durant | Haverhill |
| Kendall Emerson | Worcester |
| Homer Gage | Worcester |
| Joel E. Goldthwait | Boston |
| Wm. Phillips Graves | Boston |
| Charles H. Hare | Boston |
| Francis B. Harrington | Boston |
| Walter Clarke Howe | Boston |
| Joshua C. Hubbard | Boston |
| F. W. Johnson | Boston |
| Peer P. Johnson | Beverly |
| Daniel Fiske Jones | Boston |
| Frank H. Lahey | Boston |
| W. B. Lancaster | Boston |
| George A. Leland | Boston |
| Robert Williamson Lovett | Boston |
| Fred B. Lund | Boston |
| Samuel Jason Mixter | Boston |
| George Howard Monks | Boston |
| Franklin Spilman Newell | Boston |
| Edward Hall Nichols | Boston |
| R. F. O'Neil | Boston |
| Robert B. Osgood | Boston |
| Horace Packard | Boston |
| Charles Allen Porter | Boston |
| Edward Reynolds | Boston |
| George L. Richards | Fall River |
| E. P. Richardson | Boston |
| Jane D. Kelly Sabine | Boston |
| Charles Locke Scudder | Boston |
| Ralph Holland Seelye | Springfield |
| Channing C. Simmons | Boston |
| Mary Almira Smith | Boston |
| Robert Soutter | Boston |
| Myles Standish | Boston |
| James S. Stone | Boston |
| Augustus Thorndike | Boston |
| Philemon E. Truesdale | Fall River |
| F. H. Verhoeff | Boston |
| Richard G. Wadsworth | Boston |
| Hugh Williams | Boston |

### *MICHIGAN*

| | |
|---|---|
| Emil Amberg | Detroit |
| Ralph E. Balch | Kalamazoo |
| Max Ballin | Detroit |
| John Norval Bell | Detroit |
| Clark D. Brooks | Detroit |
| Roy B. Canfield | Ann Arbor |
| J. Henry Carstens | Detroit |
| Ray Connor | Detroit |
| Ernest K. Cullen | Detroit |
| Marshall L. Cushman | Lansing |
| C. C. Darling | Ann Arbor |
| C. B. G. de Nancrède | Ann Arbor |
| William T. Dodge | Big Rapids |
| Robert W. Gillman | Detroit |
| Herbert W. Hewitt | Detroit |
| Louis J. Hirschman | Detroit |
| R. J. Hutchinson | Grand Rapids |
| Frederick C. Kidner | Detroit |
| Daniel LaFerté | Detroit |
| Albert L. Lawbaugh | Calumet |
| Howard W. Longyear | Detroit |
| Walter P. Manton | Detroit |
| Joshua G. R. Manwaring | Flint |
| Theodore A. McGraw | Detroit |
| Wm. Francis Metcalf | Detroit |
| William H Morley | Detroit |
| Walter Robert Parker | Detroit |
| Rolland Parmeter | Detroit |
| Reuben Peterson | Ann Arbor |
| Frederick W. Robbins | Detroit |
| C. H. Sample | Saginaw |
| B. R. Schenck | Detroit |
| Burt R. Shurly | Detroit |
| Richard R. Smith | Grand Rapids |
| Harry N. Torrey | Detroit |
| Frank B. Walker | Detroit |
| F. C. Warnshuis | Grand Rapids |

D. Emmet Welch . . . . . Grand Rapids
Frank C. Witter . . . . . Petoskey

*MINNESOTA*

A. W. Abbott . . . . . Minneapolis
E. H. Beckman . . . . . Rochester
Alexander R. Colvin . . . . St. Paul
Walter Courtney . . . . . Brainard
W. A. Dennis . . . . . St. Paul
Robert Earl . . . . . St. Paul
Emil S. Geist . . . . . Minneapolis
Arthur J. Gillette . . . . . St. Paul
John H. James . . . . . Mankato
E. S. Judd . . . . . Rochester
Hannibal H. Kimball . . . . Minneapolis
Arthur Ayer Law . . . . . Minneapolis
J. Warren Little . . . . . Minneapolis
Jennings C. Litzenberg . . . . Minneapolis
Archibald MacLaren . . . . St. Paul
William H. Magie . . . . . Duluth
Arthur T. Mann . . . . . Minneapolis
Charles H. Mayo . . . . . Rochester
William J. Mayo . . . . . Rochester
James E. Moore . . . . . Minneapolis
Horace Newhart . . . . . Minneapolis
John H. Rishmiller . . . . . Minneapolis
Harry P. Ritchie . . . . . St. Paul
William E. Rochford . . . . Minneapolis
John T. Rogers . . . . . St. Paul
John L. Rothrock . . . . . St. Paul
Arnold Schwyzer . . . . . St. Paul
Gustav Schwyzer . . . . . Minneapolis
Charles N. Spratt . . . . . Minneapolis
Eugene S. Strout . . . . . Minneapolis
H. B. Sweetser . . . . . Minneapolis
Frank C. Todd . . . . . Minneapolis
Franklin R. Wright . . . . Minneapolis

*MISSISSIPPI*

Hugh A. Gamble . . . . . Greenville
B. B. Martin . . . . . Vicksburg
Harley R. Shands . . . . . Jackson

*MISSOURI*

Nathaniel Allison . . . . . St. Louis
F. W. Bailey . . . . . St. Louis
Willard Bartlett . . . . . St. Louis
J. F. Binnie . . . . . Kansas City
Vilray P. Blair . . . . . St. Louis
John Young Brown . . . . . St. Louis
George W. Cale, Jr. . . . . St. Louis
N. B. Carson . . . . . St. Louis
J. W. Charles . . . . . St. Louis
Malvern B. Clopton . . . . St. Louis
W. T. Coughlin . . . . . St. Louis
Harry Sturgeon Crossen . . . St. Louis
Walter B. Dorsett . . . . . St. Louis
Oscar H. Elbrecht . . . . . St. Louis
W. J. Frick . . . . . Kansas City
Eugene C. Gehrung . . . . . St. Louis
Jacob Geiger . . . . . St. Joseph
George Gelhorn . . . . . St. Louis
Frank A. Glasgow . . . . . St. Louis
J. D. Griffith . . . . . Kansas City
J. G. Hayden . . . . . Kansas City
A. E. Hertzler . . . . . Kansas City
Howard Hill . . . . . Kansas City
Roland Hill . . . . . St. Louis
Jabez N. Jackson . . . . . Kansas City
Ernst Jonas . . . . . St. Louis
Walter C. G. Kirchner . . . . St. Louis
Bransford Lewis . . . . . St. Louis
Hanau W. Loeb . . . . . St. Louis
James E. Logan . . . . . Kansas City
Frank J. Lutz . . . . . St. Louis
F. M. McCallum . . . . . Kansas City
Harvey G. Mudd . . . . . St. Louis
Fred T. Murphy . . . . . St. Louis
Clarence M. Nicholson . . . St. Louis
Frank G. Nifong . . . . . Columbia
Archer O'Reilly . . . . . St. Louis
John M. Perkins . . . . . Kansas City
Francis Reder . . . . . St. Louis
Ernest F. Robinson . . . . Kansas City
W. E. Sauer . . . . . St. Louis
M. G. Seelig . . . . . St. Louis
William A. Shoemaker . . . . St. Louis
Selden Spencer . . . . . St. Louis
Jackson B. Taulbee . . . . . Joplin
Frederick J. Taussig . . . . St. Louis
John H. Thompson . . . . . Kansas City
Herman Tuholske . . . . . St. Louis
Paul Y. Tupper . . . . . St. Louis

*MONTANA*

T. Casey Witherspoon . . . . Butte

*NEBRASKA*

Simon C. Beede . . . . . David City
C. DeWitt Bryant . . . . . Omaha
B. B. Davis . . . . . Omaha
Palmer Findley . . . . . Omaha
Harold Gifford . . . . . Omaha
August F. Jonas . . . . . Omaha
John Prentiss Lord . . . . . Omaha
Albert R. Mitchell . . . . . Lincoln
H. Winnett Orr . . . . . Lincoln
Harold P. Salter . . . . . Norfolk
John E. Summers . . . . . Omaha

*NEW JERSEY*

| | |
|---|---|
| Robert Morrison Curts | Paterson |
| W. E. Darnall | Atlantic City |
| Gordon K. Dickinson | Jersey City |
| Linn Emerson | Orange |
| Charles L. Ill | Newark |
| Edward Joseph Ill | Newark |
| Walter B. Johnson | Paterson |
| John C. McCoy | Paterson |

*NEW YORK*

| | |
|---|---|
| Robert Abbe | New York |
| Fred Houdlett Albee | New York |
| L. Grant Baldwin | Brooklyn |
| Gorham Bacon | New York |
| Samuel Wyllys Bandler | New York |
| L. Bolton Bangs | New York |
| Arthur J. Bedell | Albany |
| A. G. Bennett | Buffalo |
| T. Passmore Berens | New York |
| W. H. Bishop | New York |
| Dougal Bissell | New York |
| Joseph A. Blake | New York |
| J. A. Bodine | New York |
| Arthur H. Bogart | Brooklyn |
| John Bion Bogart | Brooklyn |
| Hermann J. Boldt | New York |
| George Emerson Brewer | New York |
| Wm. Barrett Brinsmade | Brooklyn |
| LeRoy Broun | New York |
| Joseph D. Bryant | New York |
| W. Sohier Bryant | New York |
| Henry G. Bugbee | New York |
| Peter A. Callan | New York |
| Wm. Francis Campbell | Brooklyn |
| Alexis L. B. Carrel | New York |
| Walter F. Chappell | New York |
| C. H. Chetwood | New York |
| J. Bayard Clark | New York |
| Clement Cleveland | New York |
| Marshall Clinton | Buffalo |
| Gerhard H. Cocks | New York |
| H. C. Coe | New York |
| William B. Coley | New York |
| George F. Cott | Buffalo |
| E. B. Cragin | New York |
| H. Holbrook Curtis | New York |
| William Darrach | New York |
| Asa Barnes Davis | New York |
| Henry Beeckman Delatour | Brooklyn |
| Edward B. Dench | New York |
| Robert L. Dickinson | Brooklyn |
| C. N. Dowd | New York |
| Arthur B. Duel | New York |
| Warren L. Duffield | Brooklyn |
| J. Clifton Edgar | New York |
| Charles A. Elsberg | New York |
| John F. Erdmann | New York |
| Mathias Figueira | Brooklyn |
| Edwin Howe Fiske | Brooklyn |
| Ralph R. Fitch | Rochester |
| Austin Flint, Jr. | New York |
| M. L. Foster | New Rochelle |
| Russell Story Fowler | Brooklyn |
| Lee Masten Francis | Buffalo |
| Thomas R. French | Brooklyn |
| Eugene Fuller | New York |
| Henry Dawson Furniss | New York |
| James A. Gardner | Buffalo |
| Arpad G. Gerster | New York |
| Charles L. Gibson | New York |
| J. Riddle Goffe | New York |
| Charles H. Goodrich | Brooklyn |
| Onslow Allen Gordon | Brooklyn |
| Hermann Grad | New York |
| Robert H. Greene | New York |
| Ramon Guiteras | New York |
| Thomas H. Halsted | Syracuse |
| James Aitken Harrar | New York |
| John A. Hartwell | New York |
| William H. Haskin | New York |
| Herman Emil Hayd | Buffalo |
| Harold N. Hays | New York |
| L. W. Hotchkiss | New York |
| O. Paul Humpstone | Brooklyn |
| Lee M. Hurd | New York |
| George W. Jarman | New York |
| John Edward Jennings | Brooklyn |
| Adoniram Brown Judson | New York |
| Frederic Kammerer | New York |
| James C. Kennedy | Brooklyn |
| E. L. Keyes, Jr. | New York |
| Otto G. T. Kiliani | New York |
| Adrian V. S. Lambert | New York |
| W. E. Lambert | New York |
| J. C. Lester | New York |
| J. H. Lewis | Buffalo |
| F. Park Lewis | Buffalo |
| Robert Lewis | New York |
| Howard Lilienthal | New York |
| William Linder | Brooklyn |
| Samuel Lloyd | New York |
| Earl P. Lothrop | Buffalo |
| W. H. Luckett | New York |
| William C. Lusk | New York |
| Matthew D. Mann | Buffalo |
| James W. Markoe | New York |
| C. H. May | New York |
| Edgar R. McGuire | Buffalo |
| Francis W. McGuire | Buffalo |
| T. J. McKee | Buffalo |

James F. McKernon . . . . . New York
S. J. McNamara . . . . . Brooklyn
Clarence A. McWilliams . . . New York
Willy Meyer . . . . . New York
Aaron Benjamin Miller . . . Syracuse
Douglas C. Moriarta . . Saratoga Springs
Robert T. Morris . . . . . New York
Henry H. Morton . . . . . Brooklyn
Edw. W. Mulligan . . . . . Rochester
James G. Mumford . . . . Clifton Springs
Francis Wisner Murray . . . New York
Frank Richard Oastler . . . New York
Roswell Park . . . . . Buffalo
Frederick J. Parmenter . . . Buffalo
S. McA. Payne . . . . . New York
Charles H. Peck . . . . . New York
Victor C. Pederson . . . . . New York
Edward W. Pinkham . . . . New York
William Ward Plummer . . . Buffalo
John Osborn Polak . . . . . Brooklyn
William M. Polk . . . . . New York
John Wilson Poucher . . . Poughkeepsie
H. R. Price . . . . . Brooklyn
William H. Rankin . . . . . Brooklyn
Reginald M. Rawls . . . . . New York
John Sturdivant Read . . . . Brooklyn
R. G. Reese . . . . . New York
W. Scott Renner . . . . . Buffalo
George W. Roberts . . . . . New York
Jacques Cortelyou Rushmore . Brooklyn
John D. Rushmore . . . . . Brooklyn
James Edgar Sadlier . . . Poughkeepsie
Reginald Hall Sayre . . . . New York
Newton M. Shaffer . . . . . New York
John E. Sheppard . . . . . Brooklyn
Walter Aikman Sherwood . . . Brooklyn
Harmon Smith . . . . . New York
Homer E. Smith . . . . . Norwich
Robert E. Soule . . . . . New York
Thomas Bray Spence . . . . Brooklyn
J. Bentley Squier, . . . . New York
E. McD. Stanton . . . . . Schenectady
Douglas Hunt Stewart . . . New York
George D. Stewart . . . . . New York
Lewis A. Stimson . . . . . New York
William E. Studdiford . . . . New York
Arnold Sturmdorf . . . . . New York
John D. Sullivan . . . . . Brooklyn
Parker Syms . . . . . New York
Henry Ling Taylor . . . . . New York
Howard C. Taylor . . . . . New York
Harry R. Trick . . . . . Buffalo
Walter Truslow . . . . . Brooklyn
H. M. Tyson . . . . . New York
John van der Poel . . . . . New York
Albert Vander Veer . . . . Albany
Edgar A. Vander Veer . . . Albany
Hiram N. Vineberg . . . . . New York
John B. Walker . . . . . New York
George Gray Ward, Jr. . . . New York
Wilbur Ward . . . . . New York
Brooks Hughes Wells . . . . New York
James Nephew West . . . . New York
Richard Ward Westbrook . . . Brooklyn
Royal Whitman . . . . . New York
Nelson W. Wilson . . . . . Buffalo
George Woolsey . . . . . New York
Thew Wright . . . . . Buffalo
F. W. Zimmer . . . . . Rochester

*NORTH CAROLINA*

K. P. Battle, Jr. . . . . Raleigh
John Wesley Long . . . . . Greensboro
Henry Norris . . . . . Rutherfordton
Hubert Ashley Royster . . . Raleigh

*NORTH DAKOTA*

James P. Aylen . . . . . Fargo
R. D. Campbell . . . . . Grand Forks
Alexander J. McCannel . . . Minot
E. P. Quain . . . . . Bismarck
N. Oliver Ramstad . . . . . Bismarck
Paul Sorkness . . . . . Fargo

*OHIO*

James Fairchild Baldwin . . . Columbus
Frederick Stewart Baron . . . Zanesville
Chester B. Bliss . . . . . Sandusky
Wm. Evans Bruner . . . . . Cleveland
Frank E. Bunts . . . . . Cleveland
Archibald I. Carson . . . . Cincinnati
George W. Crile . . . . . Cleveland
Albert H. Freiberg . . . . Cincinnati
Walter E. Griess. . . . . Cincinnati
Joseph Arda Hall . . . . . Cincinnati
Rufus Bartlett Hall . . . . Cincinnati
C. A. Hamann . . . . . Cleveland
Charles Sumner Hamilton . . Columbus
H. H. Hines . . . . . Cincinnati
J. M. Ingersoll . . . . . Cleveland
Julius H. Jacobson . . . . . Toledo
William E. Lower . . . . . Cleveland
Benjamin Bush McClellan . . Xenia
B. L. Millikin . . . . . Cleveland
Mark Millikin . . . . . Hamilton
Charles L. Minor . . . . . Springfield
John Chadwick Oliver . . . . Cincinnati
Joseph Ransohoff . . . . . Cincinnati
Charles A. L. Reed . . . . Cincinnati
Benjamin Merrill Ricketts . . Cincinnati
Hunter Robb . . . . . Cleveland
E. G. Rust . . . . . Cleveland

ROLAND E. SKEEL . . . . . Cleveland
LEWIS FREDERIC SMEAD . . . . Toledo
MARTIN STAMM . . . . . Fremont
WALTER G. STERN . . . . . Cleveland
G. A. SULZER . . . . . Columbus
MAGNUS ALFRED TATE . . . . Cincinnati
JOHN A. THOMPSON . . . . . Cincinnati
DERRICK T. VAIL . . . . . Cincinnati
JOHN MURPHY WITHROW . . . Cincinnati
JAMES CRAVEN WOOD . . . . Cleveland
E. GUSTAV ZINKE . . . . . Cincinnati

*OKLAHOMA*

A. L. BLESH . . . . . Oklahoma City
LEROY LONG . . . . . McAlester

*OREGON*

ALVIN W. BAIRD . . . . . Portland
ROBERT C. COFFEY . . . . . Portland
LUTHER H. HAMILTON . . . . Portland
WILLIAM B. HOLDEN . . . . . Portland
FREDERICK A. KIEHLE . . . . Portland
ALBERT E. MACKAY . . . . . Portland
KENNETH A. J. MACKENZIE . . . Portland
EDW. B. MCDANIEL . . . . . Portland
HERBERT S. NICHOLS . . . . . Portland
WM. H. SKENE . . . . . Portland
ERNEST A. SOMMER . . . . . Portland
ERNEST F. TUCKER . . . . . Portland

*PENNSYLVANIA*

BROOKE M. ANSPACH . . . . Philadelphia
ASTLEY P. C. ASHHURST . . . . Philadelphia
J. MONTGOMERY BALDY . . . . Philadelphia
JOHN JENKINS BUCHANAN . . . Pittsburgh
JAMES C. BURT . . . . . Pittsburgh
S. A. CHALFANT . . . . . Pittsburgh
JOHN G. CLARK . . . . . Philadelphia
EDWARD P. DAVIS . . . . . Philadelphia
GWILYM G. DAVIS . . . . . Philadelphia
EWING WILBER DAY . . . . . Pittsburgh
HARRY CLAY DEAVER . . . . Philadelphia
JOHN BLAIR DEAVER . . . . . Philadelphia
G. E. DE SCHWEINITZ . . . . . Philadelphia
WILLIAM L. ESTES . . . . . S. Bethlehem
CURTIS SMILEY FOSTER . . . . Pittsburgh
CHARLES H. FRAZIER . . . . . Philadelphia
OTTO C. GAUB . . . . . Pittsburgh
GEORGE W. GUTHRIE . . . . Wilkes Barre
RICHARD H. HARTE . . . . . Philadelphia
GEORGE LIVINGSTON HAYS . . . Pittsburgh
EDWARD B. HECKEL . . . . . Pittsburgh
BARTON C. HIRST . . . . . Philadelphia
RALEIGH R. HUGGINS . . . . . Pittsburgh
CHEVALIER JACKSON . . . . . Pittsburgh
JOHN HOWARD JOPSON . . . . Philadelphia
JAMES W. KENNEDY . . . . . Philadelphia
WILLIAM STERLING LANGFITT . . Pittsburgh
ROBERT GRIER LECONTE . . . Philadelphia
JOHN S. MABON . . . . . Alleghany
G. HUDSON MAKUEN . . . . . Philadelphia
EDWARD MARTIN . . . . . Philadelphia
JAMES WILLIAM MACFARLANE . . Pittsburgh
STEWART LEROY MCCURDY . . . Pittsburgh
E. W. MEREDITH . . . . . Pittsburgh
HAROLD A. MILLER . . . . . Pittsburgh
ROBERT T. MILLER, JR. . . . . Pittsburgh
E. E. MONTGOMERY . . . . . Philadelphia
THOMAS R. NIELSON . . . . . Philadelphia
WILLIAM CAMPBELL POSEY . . . Philadelphia
JOHN B. ROBERTS . . . . . Philadelphia
KAY I. SANES . . . . . Pittsburgh
T. B. SCHNEIDEMAN . . . . . Philadelphia
P. N. K. SCHWENK . . . . . Philadelphia
DAVID SILVER . . . . . Pittsburgh
FRANK F. SIMPSON . . . . . Pittsburgh
JOHN DEVINNE SINGLEY . . . . Pittsburgh
GEORGE C. STOUT . . . . . Philadelphia
LORENZO W. SWOPE . . . . . Pittsburgh
LEWIS H. TAYLOR . . . . . Wilkes Barre
A. A. UHLE . . . . . Philadelphia
WILLIAM B. VAN LENNEP. . . . Philadelphia
X. O. WERDER . . . . . Pittsburgh
H. AUGUSTUS WILSON . . . . Philadelphia
JAMES K. YOUNG . . . . . Philadelphia
CHARLES EDWARD ZIEGLER . . . Pittsburgh

*RHODE ISLAND*

ARTHUR THOMS JONES . . . . Providence
JOHN W. KEEFE . . . . . Providence
JOHN W. MITCHELL . . . . . Providence
CHARLES W. STEWART . . . . Newport

*SOUTH CAROLINA*

ROBERT S. CATHCART . . . . . Charleston
CURRAN B. EARLE . . . . . Greenville
WILLIAM W. FENNELL . . . . Rock Hill
LEGRAND GUERRY . . . . . Columbia
CHARLES W. KOLLOCK . . . . Charleston

*SOUTH DAKOTA*

GILBERT GEOFFREY COTTAM . . . Sioux Falls
J. W. FREEMAN . . . . . Lead
FREDERICK A. SPAFFORD . . . . Flandreau

*TENNESSEE*

RICHARD ALEXANDER BARR . . . Nashville
WILLIAM T. BLACK . . . . . Memphis
W. A. BRYAN . . . . . Nashville
LUCIUS E. BURCH . . . . . Nashville
ROBERT CALDWELL . . . . . Nashville
MARVIN M. COLLUM . . . . . Nashville

| | |
|---|---|
| Joseph Augustus Crisler | Memphis |
| E. C. Ellett | Memphis |
| Duncan Eve | Nashville |
| Rufus E. Fort | Nashville |
| William D. Haggard | Nashville |
| Battle Malone | Memphis |
| John M. Maury | Memphis |
| W. M. McCabe | Nashville |
| M. C. McGannon | Nashville |
| S. R. Miller | Knoxville |
| J. Lancelot Minor | Memphis |
| Frank David Smythe | Memphis |
| Hilliard Wood | Nashville |

*TEXAS*

| | |
|---|---|
| James H. Bell | San Antonio |
| Hugh Woodward Crouse | El Paso |
| Bacon Saunders | Fort Worth |
| Arthur Carroll Scott | Temple |
| James Edwin Thompson | Galveston |

*UTAH*

| | |
|---|---|
| Samuel C. Baldwin | Salt Lake |

*VERMONT*

| | |
|---|---|
| Lyman Allen | Burlington |
| William Stickney | Rutland |

*VIRGINIA*

| | |
|---|---|
| Lewis C. Bosher | Richmond |
| Robert C. Bryan | Richmond |
| Joseph A. Gale | Roanoke |
| Lomax Gwathmey | Norfolk |
| George Tucker Harrison | Charlottesville |
| J. Shelton Horsley | Richmond |
| James S. Irvin | Danville |
| George Ben Johnston | Richmond |
| B. R. Kennon | Norfolk |
| Southgate Leigh | Norfolk |
| William P. Matthews | Richmond |
| Stuart McGuire | Richmond |
| Harry L. Myers | Norfolk |
| Levi Old | Norfolk |
| Robert Lee Payne, Jr. | Norfolk |
| Charles Russell Robins | Richmond |
| Hugh Henry Trout | Roanoke |
| Stephen H. Watts | University |
| A. Murat Willis | Richmond |

*WASHINGTON*

| | |
|---|---|
| I. P. Balabanoff | Tacoma |
| F. Bentley | Seattle |
| R. L. Catterson | Spokane |
| J. B. Eagleson | Seattle |
| Charles F. Eikenbary | Spokane |
| Bruce Elmore | Seattle |
| Robert D. Forbes | Seattle |
| Charles B. Ford | Seattle |
| N. H. Goodnow | Everett |
| Alfred J. Helton | North Yakima |
| George M. Horton | Seattle |
| Wilson Johnston | Spokane |
| Everett C. Jones | Seattle |
| Henry B. Luhn | Spokane |
| C. J. Lynch | North Yakima |
| J. A. MacKinnon | Seattle |
| James N. Neff | Spokane |
| E. R. Northrop | Spokane |
| Guy S. Peterkin | Seattle |
| Alfred Raymond | Seattle |
| Walter K. Seelye | Seattle |
| C. W. Sharples | Seattle |
| Hamilton Stillson | Seattle |
| Milton C. Sturgis | Seattle |
| C. A. Veasey | Spokane |
| William F. West | Everett |
| Park Weed Willis | Seattle |
| Sherald F. Wiltsie | Seattle |

*WEST VIRGINIA*

| | |
|---|---|
| John Edgarton Cannaday | Charleston |
| William W. Golden | Elkins |
| C. S. Hoffman | Keyser |
| Frank LeMoyne Hupp | Wheeling |

*WISCONSIN*

| | |
|---|---|
| John M. Dodd | Ashland |
| Edward Evans | LaCrosse |
| H. B. Hitz | Milwaukee |
| Charles H. Lemon | Milwaukee |
| John R. McDill | Milwaukee |
| Franz Pfister | Milwaukee |
| Gilbert E. Seaman | Milwaukee |
| Joseph F. Smith | Wausau |
| John Lawrence Yates | Milwaukee |

*WYOMING*

| | |
|---|---|
| George L. Strader | Cheyenne |

# DOMINION OF CANADA

## *ALBERTA*

| | |
|---|---|
| Edgar William Allin | Edmonton |
| Harry G. Mackid | Calgary |
| Frank Hamilton Mewburn | Calgary |

## *BRITISH COLUMBIA*

| | |
|---|---|
| S. Bonnell | Fernie |
| R. B. Boucher | Vancouver |
| Ivan Glen Campbell | Vancouver |
| Douglas Corsan | Fernie |
| R. V. Dolbey | Vancouver |
| George S. Gordon | Vancouver |
| J. H. King | Cranbrook |
| Robert E. McKechnie | Vancouver |
| W. B. McKechnie | Vancouver |
| F. X. McPhillips | Vancouver |
| A. S. Monro | Vancouver |
| Harold Edward Ridewood | Victoria |
| H. W. Riggs | Vancouver |
| William H. Sutherland | Revelstoke |

## *MANITOBA*

| | |
|---|---|
| William A. Bigelow | Brandon |
| R. J. Blanchard | Winnipeg |
| B. J. Brandson | Winnipeg |
| H. P. H. Galloway | Winnipeg |
| J. A. Gunn | Winnipeg |
| Jasper Halpenny | Winnipeg |
| G. Hiebert | Winnipeg |
| J. E. Lehmann | Winnipeg |
| N. J. Maclean | Winnipeg |
| James E. McKenty | Winnipeg |
| S. W. Prowse | Winnipeg |
| Wm. Robson Nichols | Winnipeg |
| R. M. Simpson | Winnipeg |
| W. Harvey Smith | Winnipeg |

## *NEW BRUNSWICK*

| | |
|---|---|
| Alfred Bennison Atherton | Fredericton |
| Murray MacLaren | St. John |
| G. Clowse Van Wart | Fredericton |
| Thomas Dyson Walker | St. John |

## *ONTARIO*

| | |
|---|---|
| George A. Bingham | Toronto |
| Geoffrey Boyd | Toronto |
| Herbert A. Bruce | Toronto |
| Irving H. Cameron | Toronto |
| Frederick A. Cleland | Toronto |
| W. E. Gallie | Toronto |
| R. J. Gibson | Sault Ste. Marie |
| W. B. Hendry | Toronto |
| Wm. Warner Jones | Toronto |
| Edmund E. King | Toronto |
| W. J. O. Malloch | Toronto |
| Frederick W. Marlow | Toronto |
| J. A. McCollum | Toronto |
| B. E. McKenzie | Toronto |
| Walter McKeown | Toronto |
| Andrew Samuel Moorhead | Toronto |
| A. Primrose | Toronto |
| Richard A. Reeve | Toronto |
| J. A. Roberts | Toronto |
| E. S. Ryerson | Toronto |
| Wallace Arthur Scott | Toronto |
| Norman S. Shenstone | Toronto |
| G. Silverthorn | Toronto |
| Clarence L. Starr | Toronto |
| F. N. G. Starr | Toronto |
| Hadley Williams | London |
| David James Gibb Wishart | Toronto |
| John Wishart | London |
| A. B. Wright | Toronto |

## *QUEBEC*

| | |
|---|---|
| E. W. Archibald | Montreal |
| George E. Armstrong | Montreal |
| Walter L. Barlow | Montreal |
| A. I. Bazin | Westmount |
| H. S. Birkett | Montreal |
| H. C. Burgess | Montreal |
| Kenneth Cameron | Montreal |
| R. P. Campbell | Montreal |
| W. W. Chipman | Montreal |
| John M. Elder | Montreal |
| Frank R. England | Montreal |
| A. McKenzie Forbes | Montreal |
| A. E. Garrow | Montreal |
| D. A. Hingston | Montreal |
| James Alexander Hutchison | Montreal |
| Wm. Hutchinson | Montreal |
| C. B. Keenan | Montreal |
| H. M. Little | Montreal |
| F. A. L. Lockhart | Montreal |
| James T. Rogers | Montreal |
| Fred T. Tooke | Montreal |
| W. G. Turner | Montreal |
| Edmond Melchior von Eberts | Montreal |

# BOOK REVIEWS

FIBROIDS OF THE UTERUS: THEIR PATHOLOGY AND TREATMENT. By Sir John Bland-Sutton, F. R. C. S. London: Science Reviews, Ltd.

In this small volume the distinguished author treats his subject according to the conventional classification and the clinical phase is emphasized throughout. The relation of fibroids to pregnancy, labor, and the puerperium, to uterine carcinoma and to the bladder and ureters are given particular attention in special chapters. Multiparity as an etiologic factor in fibrosis uteri is ignored, this pathologic condition being regarded rather as an end product of septic infection, and at that of the long standing Neisserian type. Adenomyoma is regarded as the product of epithelial overgrowth with a responsive increase of the connective tissue in which the glands are implanted, this being attributed, again, to the action of micro-organisms. Pulmonary embolism after abdominal hysterectomy and the relation of thrombosis and embolism to septic infection of the uterus is considered at length. Argument in favor of supravaginal hysterectomy as opposed to total extirpation is ably set forth in the final chapter. This operation is regarded as unrivaled among surgical procedures for its ability to amend invalid women by thousands, enabling them to lead useful lives as well as to be companions to their husbands and mothers to their children.

The illustrations are plentiful, for the most part picturing gross pathology. Instead of an elaborate and complete bibliography, the author has appended to the various chapters lists of references, many of which serve as milestones indicating the progress in pelvic surgery. CAREY CULBERTSON.

THE NARCOTIC DRUG DISEASES AND ALLIED AILMENTS. By Geo. E. Pettey, M. D. Philadelphia: F. A. Davis Company, 1913.

This book is a presentation of the subject of narcotic drug diseases based upon the author's wide experience. Throughout the book emphasis is placed upon the conception of drug addiction as being in effect a disease and should be treated as such. It is a meritorious monograph in which the conceptions of the author are recorded in detail. It is of special value in so far as the outlined treatment is concerned, the author having made plain, and apparently very simple, each step in the management of these refractory cases.

Included in the details of treatment are favorite prescriptions, and a discussion of the effects to be derived from the use of such drugs as scopolamine, hyoscine, strychnine, and certain cathartics. It is well written, adequately illuminated by case reports, and is for the most part convincing.

The book contains a discussion of physical training and dietetics as employed in the treatment of the drug diseases, and also several chapters devoted to a discussion of the "literature" upon this subject, consisting in excerpts from the writings of other authors, followed by "author's comments," in which these writings are criticized.

CHARLES A. ELLIOTT.

VACCINE AND SERUM THERAPY. By Edwin Henry Schorer, B.S., M.D. St. Louis: C. V. Mosby Company, 1913.

Primarily a review of authorities on this very important subject, with a view to bringing more recent discoveries down to date and presenting in a concise manner the later theoretical and laboratory specific diagnosis of serum therapy.

The author has been patient and painstaking in giving details as to the laboratory technique in specific diagnosis, therapy and treatment. While parts of the work are extremely theoretical and of interest only to specialists in this line, the general scope makes up a manual that is of much value to the general practitioner, as well as the specialist, in every form of medicine and surgery. Considerable space is devoted to a discussion of the opsonic index and the importance of opsonin in health and disease. The author has successfully established theoretical and experimental evidence as well as clinical application of the specific treatment of bacterial disease. To accomplish this some space has been given to infections in general and the theories of immunity with special emphasis to the opsonic theory of immunity.

THE MODERN TREATMENT OF NERVOUS AND MENTAL DISEASES. By American and British authors. Edited by William A. White, M.D., and Smith Ely Jelliffe, A.M., M.D., Ph.D. Philadelphia and New York: Lea & Febiger.

Volume I of this work is made up of nineteen chapters by as many foremost authors and is a consistent and comprehensive outline of a rational therapeutics of diseases of the nervous system and the mind. In order to better serve its purpose the editors have arranged the subject matter so that diseases related etiologically are discussed together and in such a way as to appeal not only to the physician but to the educator, the legislator, the judge and lawyer, the student of criminology, immigration, and of dangerous trades; in fact, for all who are interested in nervous and mental hygiene.

The parts devoted to syphilis of the nervous system are comprehensive and while the therapeutic requirements are held uppermost, the various clinical entities are differentiated yet brought together and discussed and appropriate treatment outlined.

Chapter I deals with eugenics in nervous and mental diseases. Chapter III with sexual problems, their nervous and mental relations.

Chapter IV with the educational treatment of the feeble-minded.

Chapter VIII with the treatment of the neuroses, including the psychoneuroses.

Chapter XVI with presenile arteriosclerotic and senile disorders of the brain and cord.

The work is decidedly one of preventive medicine and differs widely from the ordinary textbook in that it is planned on a broad scale and emphasizes the fact that the psychical side of life merits quite as much consideration as the physical, offering reconstructive factors in social organization and applying them to human ills. The book is clearly written, comprehensible alike to physician and layman whose education has been sufficient to stimulate an interest in human welfare. H. A. POTTS.

PREVENTIVE MEDICINE AND HYGIENE. By Milton J. Rosenau, M. D. New York: D. Appleton & Co., 1913.

This work is in effect a textbook upon the subject of preventive medicine. It is an excellent and concise presentation of the subject, and is a textbook that is certain to take a prominent place among the standard textbooks of medicine. The facts brought together in this volume are derived from diverse and widely scattered sources, from the broad fields of many related sciences, and being readable and compactly put together in logical sequence, form a valuable work for both the student and sanitary officer.

Using an excellent textbook style, the author has illuminated the subjects discussed with sufficient concrete examples, illustrating the points discussed, and by so doing has not cumbered the book with much of the dead wood so often found in monographs treating upon these same subjects.

The book deals with broadly diversified, yet properly related subjects, including a detailed discussion of the infectious diseases, insect born diseases, quarantine, immunity, heredity, eugenics, epilepsy, food, ventilation, public water supply, ice, sewage disposal, vital statistics, occupational diseases, disinfection, and many other related subjects, treating them always from the preventive medical viewpoint and properly linking them together so as to give an adequate idea of this broad subject.

The chapter upon immunity is particularly instructive, including a discussion of the mechanism of immunity, bacillus carriers, latency, Ehrlich's side chain theory, the nature of toxines, antitoxines, phagocytosis, anaphylaxis, etc., all being presented in textbook manner, the main facts being given with didactic precision.

The section devoted to foods is comprehensive, although necessarily compact, to fit the scope of the book. A general treatment of the whole subject is presented, including a classification of foods, a discussion of adulteration of foods, decomposition, preservation and preparation of foods. The chapter upon milk is short yet adequate, and includes a discussion of milk supply, classification, adulteration, diseases spread by milk, and the methods for the examination of milk. The chapter upon meat covers a discussion of such subjects as the production, preservation and inspection of meat. The various diseases produced by the consumption of infected and spoiled meat is thoroughly and satisfactorily dealt with. The subjects of eggs and vegetable supply are dealt with in the same way.

The sections devoted to air, water, sewage and refuse disposal are fitting for the scope of this work. Ventilation, heating and the effects of vitiated air are discussed as well as water supply, the analysis of water, the methods of purifying water, and water and its relation to disease.

These are all subjects which should be taken up in the class room, and to the mind of the reviewer no more compact, yet logical and comprehensive textbook, fulfilling the requirements of the class room, has been written. The eminence of the author, the logical classification of subjects, and the authoritative manner of presentation, stamp this book as a textbook of the first order, to be considered along with Osler, Adami, and others of the undying textbooks that stay throughout the years.

CHARLES A. ELLIOTT.

GENITO-URINARY DIAGNOSIS AND THERAPY. By Ernst Portner, M. D. A Translation from the German by Bransford Lewis. St. Louis: C. V. Mosby Co.

The title is misleading, as the book is intended only to present therapeutic measures in genito-urinary diseases. Very rarely indeed is any reference made to diagnosis, such reference being made to emphasize certain important points. In its translation the book has been so freely edited by Lewis that it assumes the aspect of co-authorship. The manual is full of brilliant, concise instructions in the matter of preventative, palliative and radical therapeutics. No space is wasted in a review of the authorities or the exploitation of theoretical hobbies so common in the medical literature of the present day. Brevity has enabled the author to comprehensively treat, in a matter of 200 pages, the therapy of the entire field of genito-urinary diseases and has left him space to review in separate chapters those genito-urinary diseases of women and children which present special peculiarities. The book is well suited to the needs of the student, general practitioner and specialist because of the intensity, clarity and brevity of the text.

SURGERY, GYNECOLOGY AND OBSTETRICS

AN INTERNATIONAL MAGAZINE, PUBLISHED MONTHLY

VOLUME XVIII FEBRUARY, 1914 NUMBER 2

# A PRELIMINARY REPORT ON A SIMPLE AND RAPID METHOD OF PYLORIC CLOSURE IN GASTRO-ENTEROSTOMY [1]

BY GEORGE EMERSON BREWER, M. D., NEW YORK CITY
Professor of Clinical Surgery, Columbia University; Attending Surgeon to the Roosevelt Hospital

THE object of this communication is to report and place on record the results of a series of experiments undertaken to determine a rapid and safe procedure by which the pylorus can be temporarily or permanently closed during the operation of gastrojejunostomy. Ever since the employment of gastrojejunostomy in the treatment of gastric or duodenal ulcer, surgeons have recognized the desirability, under certain conditions, of effecting a closure of the pylorus.

While considerable difference of opinion has prevailed and still prevails regarding the advantages of pyloric closure in the various conditions in which gastrojejunostomy is indicated, and while it is neither desirable nor necessary on this occasion to enter into a discussion of these problems, all surgeons of experience will agree that in at least one group of cases, namely in bleeding duodenal ulcers, closure of the pylorus is positively indicated.

In the past many methods have been suggested and practiced to bring about this result. The simplest of these is closure by means of a tightly-drawn constricting ligature, with or without preliminary contusion of the parts, as suggested by Kelling; but unfortunately this has been found to be insufficient, for both animal experiments and clinical observation in the human subject have proven that the closure thus produced is a temporary one, as the ligature quickly causes a necrosis of the constricted area, the proximal and distal peritoneal surfaces brought in contact by the application of the ligature quickly unite; and when the necrotic area separates the lumen is re-established. Closure of the pylorus by means of infolding sutures, as suggested by Moynihan and Kelling; by means of a submucous plastic operation, as advocated by Girard; by means of a pedunculated seromuscular flap from the anterior gastric wall; or by a ligature of free transplanted autoplastic material, as proposed by Wilms, have all been employed, in some instances with encouraging results. F. H. Tappeiner,[2] however, reports a series of animal experiments with all of these methods. All of his dogs lived with the exception of one, which died at the end of two weeks from pulmonary embolism.

The specimens from the successfully operated dogs were removed after four, seven, and ten weeks.

As a result of a careful study of these specimens, the author states that not even a temporary constriction of the dog's pylorus could be accomplished either with infolding sutures, according to Kelling's method, with the submucous plastic, according to Girard, or with a pedunculated plastic from the anterior gastric wall. The same remark ap-

[2] Beitr. z. klin. Chir., 1912.

[1] Presidential address, Clinical Congress of Surgeons of North America, Chicago, November 10, 1913.

Fig. 1. Stomach from dog described in Experiment 1 showing aluminum band completely covered by new-formed tissue.

plied to thread ligature after contusion of the pylorus, for the ligature is promptly expelled into the intestinal lumen, and this is rapidly followed by a re-establishment of the pyloric canal. Better results are obtained by thread constriction without contusion of the pylorus, for in these cases a longer time is required for the migration of the thread through the pyloric wall. At the instant, however, that its transit is completed, the pylorus again becomes distended, for no solid resistant scar is formed during the experiment.

Still, the author states, it should be kept in mind that the muscle of the gastro-intestinal wall is not so strong in men as in dogs, the tissues of which, according to Schloffer,

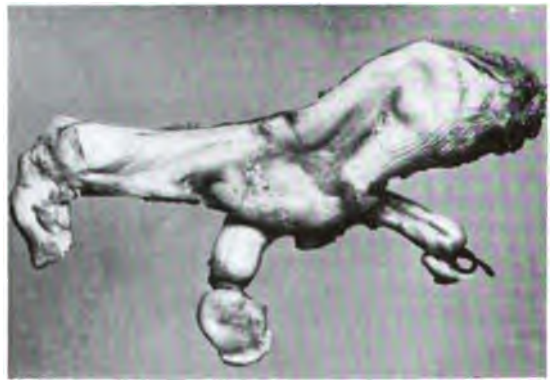


Fig. 2. Stomach from Experiment 2. Aluminum band in place, completely covered.

Fig. 3. Body and pylorus of stomach from Experiment 3 filled with water and tacked to a board, pylorus downward, showing no leakage.

possess a greatly superior capacity of regeneration; and it is possible that the threads take a much longer time to cut through in man as compared with dogs. Still better results are accomplished with the free transplanted strip of fascia, for this does not pass through the stomach wall but forms organic adhesions with it. Moreover, ligature with the strip of fascia can be completed almost as rapidly as with an ordinary thread, certainly much more rapidly than the gastric wall plastics.

As early as 1895, von Eiselsberg devised and practiced an operation which he designated *unilateral pyloric exclusion*. This consisted in a complete transverse division of the stomach proximal to the pylorus, and closure of the proximal and distal openings by Lembert sutures. This operation was originally devised to prevent irritation of inoperable carcinomatous ulcers of the pylorus by totally excluding from them the gastric secretions. Later he and his followers employed it in benign ulcers of the pyloric region as well as in ulcers of the duodenum.

That this method is universally successful is evidenced not only by von Eiselsberg's statistics, but by those of Haberer and others.

Fig. 4. Pyloric end of stomach, filled with water, showing no leakage from duodenum.

In the closing paragraphs of Tappeiner's report, the author remarks that he "believes himself justified in stating that the very best method of pyloric closure is undoubtedly the method of von Eiselsberg," although he recognizes certain disadvantages in this often prolonged procedure.

While all surgeons will agree that the method of von Eiselsberg can be relied upon to effect permanent closure in every instance, it will also be recognized that the procedure is necessarily a long one; and especially in cases of bleeding duodenal or gastric ulcers the patients are in no condition to withstand the added shock of such an operation. Moreover, there must also be considered the risk of infection where the gastro-intestinal tract is thus opened a second time.

Stimulated by the successful results of Halsted in effecting closure of the larger arteries by means of aluminum bands, the writer undertook a series of experiments in the Surgical Research Laboratory of the College of Physicians and Surgeons, to determine if this method could not be employed in pyloric closure.

Advantage was taken of the classwork in operative surgery, and days were chosen when the operation of gastrojejunostomy was demonstrated.

Fig. 5. Stomach from Experiment 4, after removal of band.

As soon as the anastomosis was completed, the pylorus was exposed and a closed Kocher's forcep passed beneath the pylorus through the mesentery. The forceps were next opened to enlarge the mesenteric rent, and a strip of sheet aluminum 1 cm. in width and about 5 cm. in length was drawn backward with the forceps through the mesenteric opening. This was next rolled with the fingers snugly around the pylorus, with sufficient compression to obliterate its lumen. The abdomen was then closed by layer suture. The application of the band in this manner took less than a minute, and while it effectively closed the pylorus, did not compromise the vitality of the tissues, as the following record of the experiments will show.

Experiment 1. Laboratory No. 75. After a posterior gastrojejunostomy by the suture method,

Fig. 6. Transverse section of restored pylorus, Experiment 5.

Fig. 7. Stomach from Experiment 6 showing aluminum band only partly hidden by new-formed tissue. Band applied 2 cm. proximal to pylorus. Dog killed on ninth day after operation.

an aluminum band was passed around the pylorus by the method just described and tightly molded into a circular constricting ring. Abdomen closed by layer suture, a dressing applied and the dog placed in the hospital. No marked reaction followed the operation, and the dog was discharged to the kennels in three weeks. Two months and ten days from the operation the animal was killed. Autopsy showed the band to be completely covered by newly formed tissue with but few adhesions. Stomach and a portion of the duodenum, with the ascending and descending portions of the jejunum, removed and

Fig. 9. Stomach from Experiment 8. Band incompletely covered after seven days.

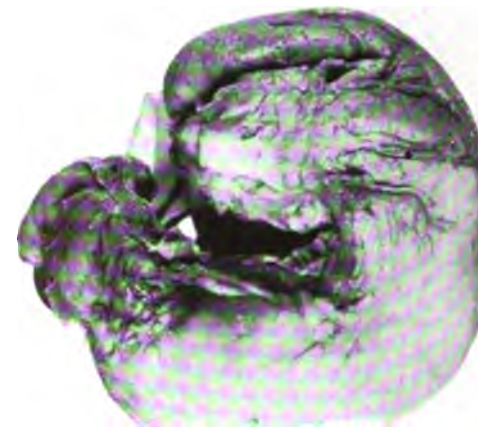


Fig. 8. Stomach from Experiment 7. Band covered.

freed from omentum. Fig. 1 shows this specimen as it was removed at autopsy.

Experiment 2. Laboratory No. 76. After gastrojejunostomy, band applied to pylorus in same manner as in experiment. No untoward symptoms during convalescence. Dog discharged to kennels in five weeks. Two months and ten days later dog killed. Autopsy showed band completely buried and invisible. Few adhesions. Fig. 2 represents this stomach after removal and after the attached omental tissue was dissected away.

Both of these specimens were preserved intact for laboratory demonstrations.

Experiment 3. Laboratory No. 77. Same procedure as in other two experiments. Dog died on twelfth day of pneumonia. Autopsy showed no evidence of peritoneal infection. Band completely covered and invisible. Small dark area just distal to band on anterior surface of duodenum, thought to

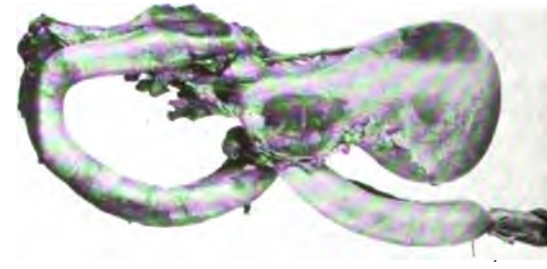


Fig. 10. Stomach from Experiment 9. Band about antrum removed at second operation.

Fig. 11.

Fig. 12.

Fig. 11. Section through pyloric antrum after removal of aluminum band at second operation, showing lumen restored, Experiment 9.

Fig. 12. Transverse section of occluded pylorus; aluminum band in place, Experiment 3.

Fig. 13.

Fig. 16.

Fig. 13. Transverse section of occluded pylorus, aluminum band in place, Experiment 4.

Fig. 16. Gross appearance of pylorus closed by aluminum band, from proximal or stomach side, Experiment 3.

be necrotic, but on microscopic section and examination found to be simply a small subserous ecchymosis. After removal of the omental tissue and ligation of the ascending and descending loops of the attached jejunum, the fundus was cut across and the viscus filled with water to see if any leakage through the closed pylorus could be detected. The closure was found to be complete.

Experiment 4. Laboratory No. 78. Same procedure as in other animals. Dog died on nineteenth day from gastric dilatation. Autopsy showed band completely covered and invisible. Distal loop of jejunum obstructed by valve-like fold of mucous membrane. Stomach dilated and partly filled with cloudy fluid. After removal of the stomach from the abdomen, it was cut across about 12 cm. proximal to the pylorus. The water test as described in the last experiment was applied. No fluid escaped from the duodenal opening. Figs. 3 and 4 represent these specimens filled with water, tacked to a board, duodenal extremity downward, showing no leakage.

Experiment 5. Laboratory No. 390. Pyloric band applied as in other animals. No reaction. Dog remained well sixty-seven days, when second operation was performed. Abdomen reopened, band found completely hidden by newly formed tissue. This was incised and the band easily removed. Abdomen closed by layer suture. No reaction following the second operation, the dog was discharged to the kennels in eleven days. Several days later dog killed. Autopsy showed pylorus apparently patent. Stomach removed and freed of omentum.

Fig. 5 represents posterior view of stomach after removal. Pylorus cut through showing restoration of lumen with no evidence of necrosis of mucous membrane or muscular coat at site of previous constriction. Fig. 6 represents cut section through the now open pylorus.

Experiment 6. Laboratory No. 391. Same procedure with the exception that band was applied to pyloric antrum about 2 cm. proximal to pylorus. Somewhat heavier material used, and more force applied to effect constriction. Dog suffered from

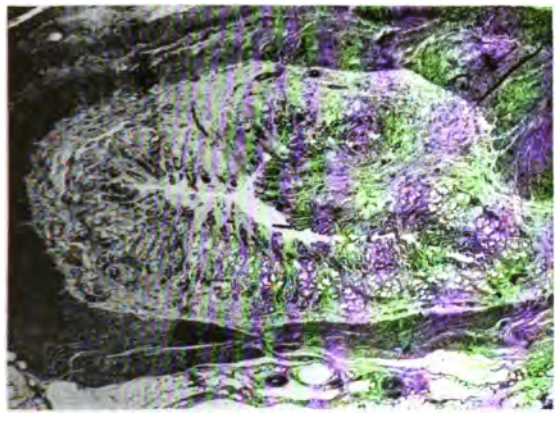


Fig. 14. Microscopic section of closed pylorus in Experiment 3 (low power).

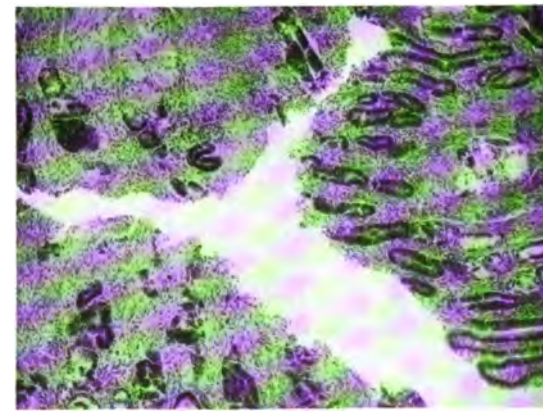


Fig. 15. Microscopic section (higher power) Experiment 3.

distemper and was killed on ninth day. No peritonitis. Band partly covered. Superficial wound of stomach by edge of band in repair. Complete stenosis demonstrated by water test (Fig. 7).

Experiment 7. Laboratory No. 392. Pyloric band applied in usual manner. Dog became ill and died with signs of sepsis. Autopsy showed pneumonia and peritoneal exudate, but no sign of leakage. Band completely covered. Dark area near band due to subperitoneal ecchymosis (Fig. 8).

Experiment 8. Laboratory No. 393. Stomach antrum occluded by band as in Experiment 6 2½ cm. from pylorus. Died in seven days of pneumonia. On autopsy, band was found only partly covered by new tissue. No signs of necrosis (Fig. 9).

Experiment 9. Laboratory No. 435. Anterior gastro-enterostomy. Band applied about 2 cm. proximal to pylorus. No untoward symptoms followed, and nineteen days later the abdomen was reopened and the band, which was completely hidden, was removed as in Experiment 5. No reaction followed the second operation. Dog subsequently killed. Autopsy showed pylorus apparently open and free from signs of pressure necrosis.

Fig. 10 shows anterior view of this stomach after removal. Fig. 11 shows cut section through previously constricted area.

The stomachs in Experiments 3 and 5 which had been proven to be occluded by the water test were further examined by sawing through the band and occluded areas. Figs. 12 and 13 show the appearance of the cut surfaces and Figs. 14 and 15 the microscopic appearances from sections cut after removal of the aluminum band from the tissues.

These sections show no evidence of necrosis of the mucous, submucous, muscular, or serous tissues. Fig. 16 shows the gross appearance of the occluded pylorus viewed from the proximal or stomach side.

A review of these experiments will show that the aluminum band produced a mechanical closure of the pylorus in every instance; that in every experiment in which the animal lived more than nine days the band was completely embedded in newly formed tissue and invisible; and that in none of the animals did the application of the band give rise to necrosis of the compressed tissues, signs of irritation or leakage.

# NEOPLASMS OF THE RENAL PELVIS WITH ESPECIAL REFERENCE TO TRANSPLANTATION IN THE URETER AND BLADDER[1]

By WILLIAM E. LOWER, M. D., Cleveland, Ohio

PRIMARY tumors of the renal pelvis are very rare. Watson and Cunningham (1) report that Israel found only 2 cases of kidney pelvis tumors as compared with 68 in the kidney parenchyma, and that there was but one tumor (a papilloma) in 94 cases of renal and perirenal growths recorded at the Massachusetts General and Boston City Hospitals in 10 years. In 1904, Albarran and Imbert in their book, "Traité des Tumeurs du Rein," found only six instances in all of the literature on the subject. Stüsser (2), in 1912, reported a considerable number of tumors of the renal pelvis and a small number in which the ureter and bladder were also involved.

To the number of recorded cases in which there was transplantation into the bladder I desire to add another which came under my observation within the last year.

An unmarried woman, 63 years of age, was referred to me by her family physician, Dr. I. J. Wright, on August 5, 1912, because of hæmaturia.

*Family history.* Father died at the age of 84, mother at age of 83. The family history was negative for cancer, tuberculosis and goiter.

*Personal history.* She has had the usual diseases of childhood. Scarlet fever at age of 6. Never had typhoid fever or pneumonia. General health has been good until within the last three or four years. She has had no cough, generally a good appetite. Has had two gastro-intestinal upsets. Menses began at age of 11, have always been regular and not painful. Menopause at age of 53. Has had no vaginal hæmorrhage since. Five years ago patient strained her back in lifting. Following this she had considerable pain and soreness in back, which gradually wore off.

*Present illness.* For the past three years patient has passed bloody urine at various times. The first time she noticed the bleeding was after an acute retention caused by a large blood clot which obstructed the urethra. She has lost considerable blood in the past three years. Has had some dull pain in the back; this was perhaps more noticeable in the region of the left kidney. At the time of examination she was quite pale and weak.

*Physical examination* showed a well-nourished person with rather white skin, mucous membrane pale, but free from scars, eruptions or pigmentations. Vision was poor in the left eye, pupils were equal and regular and reacted to light and color. Some slight enlargement of the submaxillary and submental glands. No tumors palpable in the breasts. Lungs were resonant throughout and showed good excursions at the bases. Precordial area did not bulge and no thrills or friction rubs palpable. Heart about normal in size and the sounds were distinct; no murmurs discernible. Pulse was regular, rhythmic and of good volume; 90 per minute. No apparent enlargement of the liver. Both kidneys were palpable and the left somewhat tender. Extremities were symmetrical and reflexes active.

*Cystoscopic examination.* Bladder capacity 150 ccm. Introduction of the cystoscope easy. Situated just to the left of the left ureteral orifice was a dark tumor mass about the size of a hickory-nut. Upon closer inspection this was apparently an organized blood clot. It was adherent to the mucous membrane and could not be detached by the beak of the cystoscope.

After observing the rest of the bladder, which was found free from growth, stone or ulcer, and then reinspecting the tumor, a small amount of blood was seen upon the mucous membrane in that locality. My first impression was that the bleeding came from the base of this clot, but after a little longer inspection blood was seen to be spurting at irregular intervals from the left ureteral orifice. The urine from the right ureter was clear. The diagnosis of left renal hæmaturia was established but the exact cause undetermined. An exploratory operation was advised but declined at this time. As there was a possibility of this being a so-called essential hæmaturia injections of serum were recommended. The patient returned to her home and I heard nothing more from the case until October 19th, when she returned stating that she had been bleeding more or less continuously since her previous visit. She had had several injections of the serum without any definite benefit. Had lost considerable in weight and seemed paler and much more feeble than at the previous examination.

She was sent to the Lakeside Hospital and on October 21st another cystoscopic examination was made.

At this time the bladder capacity was 300 ccm. Introduction of the cystoscope easy. The dark tumor which had been observed at the previous examination was still present and it was plainly to be seen that this blood clot was adherent to a growth, only a small part of which was visible beneath the clot. In addition to this tumor, which had been observed at the previous examination, there was another growth about one-half the size of the larger tumor, situated upon the other side of the

[1] Read before the American Association of Genito-Urinary Surgeons, Washington, May, 1913.

Fig. 1. Growth in bladder, removed at time of first operation.

left ureteral orifice about one-quarter of an inch from the opening, as shown in Fig. 1. This was papillomatous in appearance, and was not bleeding. The ureters were catheterized, urine flowed freely from the right side, but only a small amount of turbid urine was obtained from the left side. Phenolsulphonephthalein intravenously appeared on the right side in three minutes and at the end of fifteen minutes 25 per cent was recovered. At this time there was no discernible bleeding from the ureter nor from either tumor. X-ray pictures of the kidneys and ureters were negative.

From the history of the case and from the previous examinations there seemed to be evidence enough to warrant an exploratory operation on the left kidney before undertaking to remove the tumors from the bladder, although there remained some doubt as to whether or not I might have been mistaken in the source of the bleeding. The tumors in the bladder were sufficient cause for the hæmaturia and yet the length of time that the patient had observed blood in the urine, the slight tenderness in the region of the left kidney and the appearance of the second tumor since the first examination, led us to speculate on the possibility of a tumor of the renal pelvis with transplantation into the bladder.

*Operation.* As she had stopped bleeding, the operation was delayed for a number of days, hoping that she might gain some in strength and be a better operative risk. Her hæmoglobin at this time was 60. On October 26th, under gas anæsthesia, with local infiltration of novocaine, the usual oblique incision was made for the exposure of the kidney. The kidney was found to be somewhat enlarged and the pelvis very much distended (Fig. 2). Palpation did not reveal any concretions or solid tumor, but a doughy mass could be detected. We did not consider it advisable to open the kidney pelvis lest we might infect the wound with the contents. The kidney was removed and the ureter ligated at a point about 3 inches from the kidney. At the point of division of the ureter there was no evidence of growth. The wound was closed with chromic catgut and the small cigarette drain inserted.

The patient was then placed upon her back and slightly in the Trendelenburg position. A transverse incision was made above the pubis, the recti muscles separated, the bladder exposed and opened. The tumor containing the organized blood clot, at the base of which was a papillomatous growth, was removed; it was about the size of a filbert. The point of excision was sutured with oo chromic catgut.

The other tumor was much smaller and much softer. It was removed in a similar manner and the wound closed. No other evidence of tumor was found anywhere in the bladder. The opening into the bladder was completely closed without drainage. The patient stood the operation well and there was no change in the pulse rate.

*Post-operative history.* On October 28th the wound was inspected and the drain removed from the kidney wound. It was clear and apparently healed by first intention. Patient was comfortable and voiding easily. The urine was bloody. On the 30th the clips holding the skin were removed. Patient was still passing bloody urine. This was difficult to account for but thought to be due to bleeding from the base of the tumors which had been removed from the bladder. On October 31st urine was still bloody. Bladder washed with boracic acid and adrenalin solution injected. November 2d hæmorrhage from the bladder very slight, general condition of the patient good. She was discharged November 23d in very good condition and feeling very comfortable. On January 21, 1913, patient telephoned me from her home in a near-by city that she was again having hæmorrhage from the bladder. She reported at the office on the 22d. She had gained considerably in weight, her color was much improved and she stated she felt better than she had for a number of years.

*Cystoscopic examination No. 3.* Bladder capacity 150 ccm. Introduction of the cystoscope easy. Extending from the right ureter and folding back on each side was a growth (Fig. 3). It was evident that this growth came from within the ureter and seemed to be pushing down and out of the ureteral opening as shown in the illustration. It was quite apparent that the ureter was involved and a second operation advised for its removal. She returned to the hospital and on January 28, 1913, was again operated upon under nitrous oxide anæsthesia and novocaine infiltration.

Incision was made extending from the lower end of the old scar through which the nephrectomy had been done, uniting with the scar for removal of the bladder tumors. The ureter was dissected from the scar above and completely isolated to the entrance into the bladder and a part of the bladder excised, as shown in Fig. 4. Bladder was closed and a small drain inserted down to the point of excision of the

Fig. 2. Photograph of kidney showing distended pelvis.

growth in the bladder. In removing the part of the bladder around the ureteral orifice the peritoneum was opened accidentally and immediately closed with plain catgut.

*Cystoscopic examination No. 4*, February 14, 1913. Bladder capacity 300 ccm. Around the region of the former ureteral orifice was a small mass of scar tissue and some inflammatory tissue. At the bottom of the bladder were a few small hæmorrhagic spots, otherwise the bladder mucosa seemed perfectly normal. Upon vaginal examination a small mass could be palpated in the region from which the left ureter had been removed. The mass was slightly tender and seemed to be inflammatory rather than a recurrence.

*Cystoscopic examination No. 5*, March 6, 1913. Bladder capacity 300 ccm. In the region of the former ureteral orifice there was only a contracted scar, the œdema which had been present at the previous examination had entirely disappeared, but there still remained a number of these small hæmorrhagic spots. The exact nature of these could not be definitely determined, but there was a strong suspicion that they might be the beginning of a recurrence.

*Cystoscopic examination No. 6*, April 1, 1913. At this time the bladder held 150 ccm. and situated just behind the trigonum near the area of excision of the left ureteral orifice was a small tumor mass. This was cauterized with the high frequency cautery on April 2d, and again on April 8th and 19th. At this time the bladder seemed to be in a nearly normal condition, with almost entire disappearance of the tumor, there remaining only a white slough at the site of the growth. The pathologic report of the growth in the kidney pelvis, ureter and bladder was identical, all three being malignant papilloma, as shown in Figs. 5, a, b, and c.

At this writing there is no evidence of recurrence of the growth in the region of the kidney or ureter. I am inclined to believe that the tumor at no time had gotten outside of the mucosa.

Upon opening the kidney pelvis it was found to contain considerable amount of broken down material with fringed edges along the calices, as shown in shaded part in the diagrammatic illustration (Fig. 6). The ureter contained a number of patches of the growth, but greater in abundance near the lower end of the ureter where they seemed to pile up at the constriction of the ureter into the bladder.

Microscopic section of the ureter at the point of excision of the kidney was free from any evidence of growth.

No definite theory is advanced for the cause of these neoplasms. Albarran and Imbert (3) found that in 15 per cent of their cases calculi were present and concluded that they had produced chronic irritation and thus furnished a good field for the neoplasms.

Fig. 3. Growth in bladder removed at second operation.

They usually occur between the ages of 40 and 60 years and are more frequently found in men.

As for the symptoms, they are quite variable and depend as a rule upon the stage of development. Hæmorrhage, tumor, pain, and elements in the urine generally indicate that a growth is present. The first sign is usually hæmorrhage. It may be continuous, intermittent and occasionally cases are noted in which it is absent entirely. It may also vary in amount, at times being scarcely noticeable and then again so profuse as to cause death. Cumston (4) noted that in cases of intermittent hæmotonephrosis one could usually suspect tumor of the renal pelvis. He also observed that when there is hæmaturia without retention, it points as a rule to a growth in the upper part of the renal pelvis or calices and large hæmatonephroses usually indicate neoplasms in the renal pelvis close to the ureteral orifice.

Pain is not a constant symptom nor an important one. It may come in attacks of colic, unexpectedly, and occasionally there is merely a sensation of numbness in either the opposite leg or in the loin and leg of the same side. Hartmann (5) reports a case of a man, 51 years old, who had suffered almost continuously with renal pains since his twentieth year. Another instance of long renal colic duration is Oraison's (6) case. It concerns a woman, 50 years old (at the time of report), who complained of violent renal colic from her twenty-second to her fortieth years. The

Fig. 4. Papillomatous growth in ureter and left ureteral orifice.

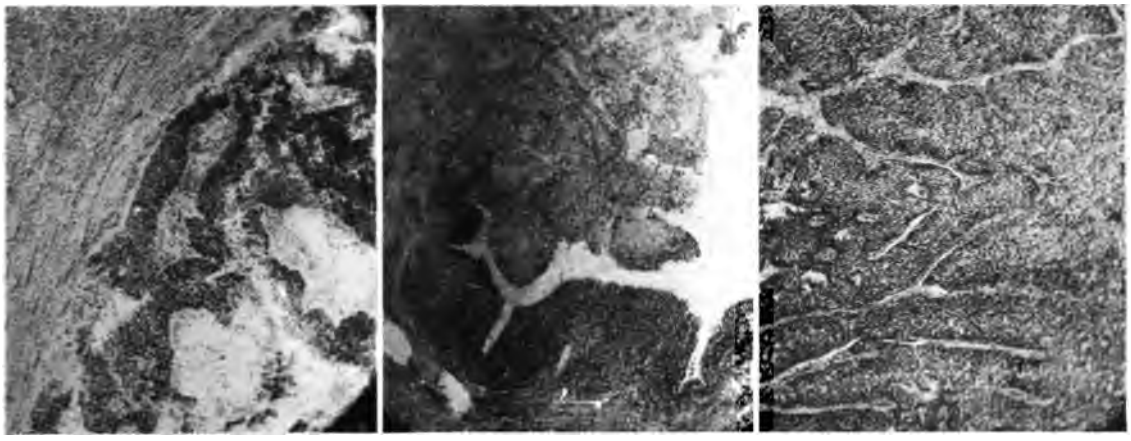


Fig. 5 A. Fig. 5 B. Fig. 5 B.

Fig. 5 A. Section of growth from the kidney pelvis.
Fig. 5 B. Section of growth from the ureter.
Fig. 5 B. Section of growth from the bladder.

pain occurred at intervals of one to three days and as a rule was followed by hæmaturia lasting several days. After she was 40 the pains were less severe but continuous.

There are also some general symptoms to be noted, such as weakness, marked pallor, loss of flesh, anæmia, and loss of appetite. Fenwick (7) has called attention to an important sign, namely, that when there is a growth in the pelvis of the kidney in which there is pelvic dilatation the ureteral orifice is altered in the nature of a dull-colored swelling and elongation of the opening of the ureteral orifice. This was not noted in my case.

It is very often hard to determine just where the growth is located, but with the aid of the cystoscope and by ureteral catheterization and injection of collargol one may make a fairly accurate diagnosis. A tumor at the ureteral orifice should lead one to suspect a growth higher up. It is not unlikely that in the recurrent tumors of the bladder, especially those situated in proximity with a ureteral orifice, the real source of the trouble is a growth in the ureter or kidney pelvis and the recurrences are transplants. Evidences of renal pelvis papilloma may be present for a long time, even months or years in a benign form, and the general health may suffer only slightly.

Sooner or later, however, it will show symptoms of malignancy. Early removal of the kidney, and I believe in most cases the ureter as well, is the only treatment.

Herewith are appended the cases of a similar condition. Case 17, reported by Picot, is of striking similarity.

Case 1. Busse's (8) case in a man, age 43, who had a sudden attack of hæmaturia and pain in the left renal region. In the following seven years they did not entirely disappear. In his fiftieth year bladder hæmorrhages brought him to the hospital. Nephrectomy was performed by Prof. Schuchardt. The patient recovered, but died of exhaustion four and one-half months after the operation. The inner surface of the renal pelvis was covered with fine villi, which reached to the ureter. There was a tumor in the bladder. The edge was covered with numerous long villi. At first these were benign, but a few months before death became malignant.

Case 2. Kohlhardt's (9) case of a woman, 69 years old. For two years she had noticed blood in the urine intermittently. The left kidney was extirpated and a villous tumor was found partly reaching into the ureter. The renal pelvis and calices were much enlarged. In the upper half of the former, close to the ureter end, was a tumor mass (the size of a small pigeon egg) which inclined toward the ureter. Small villous tumor masses were located on the entire mucous membrane of the renal pelvis and calices to the upper third of the ureter. Briefly stated, there was a multiple villous tumor formation originating in the left renal pelvis, renal calix and ureter, the bases of which showed proliferation of the same. As a result of the villi, the urine flow was hindered and hydronephrosis resulted. The patient was cured. Stüsser (10), in his account of the case, states that Kohlhardt excluded

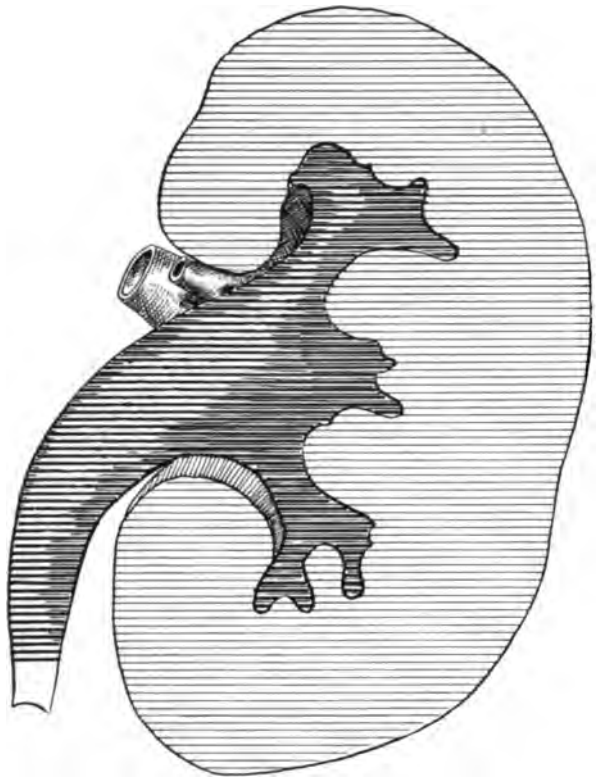


Fig. 6. Diagram showing growth in pelvis.

carcinoma and inclined toward the diagnosis "fibroma papillare diffusum" and "pyelitis villosa," and also that the patient died of regionary metastases one and one half years later.

CASE 3. Poll's (11) case of a man, 41 years old. Three and one-half cm. of the ureter was removed, also the left kidney. The renal pelvis was enlarged to the size of a man's fist. Small groups of gray-white protuberances were seen in the renal pelvis. Briefly stated, there was a villous tumor of the mucous membrane of the ureter and the renal pelvis of the left kidney, which did not penetrate deeply here, but did in the calices. He also had hæmorrhages. The growths extended toward the bladder. The specimens were examined after the death of the patient. Poll (12) says that years ago various names were used for these tumors, such as: villous polypi, villous cancers, tumores villosi, fibroma papillare, papilloma, without distinguishing between benign and malignant. To-day they go under the name of villous cancer or carcinoma papilloma. Due to reasons unknown to him, papillary growths existed on the mucous membrane of the renal pelvis and the ureter which showed plainly carcinomatous growths in the calices. It is not known positively whether they were benign or malignant at the start. It probably was carcinoma in the calix.

CASE 4. Rayer's (13) case of a woman, aged 58. She died of hæmorrhage. The autopsy showed a collection of fluid in the abdominal cavity. In the greatly enlarged liver were numberless cancer nodes of all sizes. The mesenteric glands were infiltrated with cancer. The kidney itself showed nothing. On the mucous membrane of the renal pelvis could be seen "small, pedicled tumors of gelatinous nature." Similar changes were also found in the ureter and bladder.

CASE 5. Drew's (14) case of a male, 56 years old, who was admitted to the hospital July 24, 1896, under the care of Mr. Barker. For three and one-half years at intervals he suffered pain, resembling renal colic. Other symptoms were hæmaturia, at times quite profuse, and a swelling in the abdomen. which was probably due to a large tumor, evidently renal in the left side of the abdomen. On July 30th nephrotomy was performed but no stone was found. The patient died November 11th. The wound discharged much pus, containing flakes of lymph which, under the microscope, were found to exist of renal epithelia and pus. The autopsy showed the right kidney slightly distended; the left much enlarged; the renal pelvis and calices greatly dilated; the lining membrane of the latter thickly covered with pinkish papillary growths; there were numerous spongy whitish nodules near the renal pelvis. The ureter was dilated and filled with pus. Along the length of the mucous membrane it was filled with tufts of delicate growths, attached by a narrow base. The bladder was small. A large red papillary growth was springing from the margin of the left ureteral orifice. In it was a cyst the size of a pea. The base of the villous growth did not infiltrate the wall of the bladder. Morris (15) in mentioning the case said that the growth in the renal pelvis was epithelial with cells of transitional type and those in the ureter were simple papilloma.

CASE 6. Mioni's (16) case. A man, 34 years old, had suffered with kidney colic four years. For two and one-half years he had painful hæmorrhage. The kidney upon palpation was very painful and the urine contained many erythrocytes, leucocytes and also numerous large cells of varied shape. The renal pelvis and calices were much enlarged. Both the kidney and ureter were removed to the bladder. The microscopic examination showed a typical papillomatous proliferation of the cylindrical epithelia of the renal pelvis and ureter. Several gland-like formations caused Mioni to diagnose the case as "adenocarcinoma papilliferum." Further progress of the case is unknown.

CASE 7. Matsuoka (17) reports a case of papilloma of the renal pelvis from the surgical clinic of Tokio. The diagnosis was "pyonephrosis" and nephrectomy was performed. A purulent cystic kidney with villous growths of the renal pelvis was found. The villi are transplanted to the ureter and microscopically are located upon a connective-tissue framework which is covered with a thick layer of epithelial cells. The description of this picture is

very interesting, since it shows the transition from the benign to the malignant stage.

CASE 8. Hedenius and Waldenstroem (18). The diagnosis showed bladder and kidney calculi. In the autopsy it was found that the renal pelvis was enlarged because the mucous membrane was covered with a mass the size of a hazel-nut; it was closely joined, uneven and composed of grayish-white, soft nodules. From the renal pelvis the neoplasms went to the ureter, the wall of which showed a thickness of 1.5 cm. In the histological pictures the neoplasms showed fine, connective-tissue stroma, rich in large epithelial cells of varied forms with large kernels and granular protoplasms. The bladder contained no stones.

CASE 9. Derewenko's (19) case of a woman, 54 years old, who had noticed blood in the urine since the summer of 1902. In March, 1905, she was taken to the clinic and operated on the 29th for hæmatonephrosis. The kidney was not removed. There was no trace of a new growth. The patient developed pneumonia, then a suppuration and was dismissed June 20th. In September of the same year she was received again. The diagnosis based on the previous operation was unilateral hæmorrhagic nephritis, and in October the left kidney was extirpated and the patient dismissed. In the hydronephrotic atrophied kidney were benign cauliflower new-growths. Blood was again noticed in the urine nine months later and the patient received into the hospital. At the cystoscopic examination a papillomatous formation was seen projecting from the ureteral orifice. It was radically extirpated by opening the bladder. Scarcely one-half year after her dismissal she complained of lumbago, paraplegia, retention of urine, paralysis of the bladder and rectum. Later gangrene set in and after a few days the patient died. The autopsy showed a tumor in the left renal region which destroyed the second and third lumbar vertebræ and caused metastases in the liver and lungs. This new growth was called villous cancer and it was emphasized that it was different from the new growths found before in the ureter and renal pelvis. Derewenko is of the opinion that the benign papilloma of the renal pelvis caused metastases in the retroperitoneal lymph glands at the hilum and in the aorta, which remained latent. The ureter was entirely covered with proliferations and only after removal of the kidney and ureter did these malignant proliferations begin.

CASE 10. Savory and Nash (20) report a case by Barker of a man, 56 years old who had villous carcinoma in the dilated calices and simple papillary tumors in the bladder and ureter.

CASE 11. Cattani's (21) case is that of a man 63 years old with the following history: Immovable tumor of the abdomen, hæmaturia with symptoms of cystitis and pyelitis; pains in the lumbar region; slight albuminuria; in the urine sediment were cancerous elements; cachexia, exitus. The cancerous infiltration originated at the beginning of the ureter; it was of grayish color and partly ulcerated. The tumor, which was transplanted to the renal pelvis and had advanced to the cortex of the kidney, was found to be a medullary carcinoma.

CASE 12. Bradford's (22) case of a male, age 44, who was brought to the hospital October 1, 1897, with a severe attack of delirium tremens and severe hæmaturia. Six months ago he noticed blood in the urine for one week. A large tumor was found in the left hypochondrium extending down to the umbilicus. The patient died October 5th. The post-mortem showed that the tumor felt during life was the left kidney. There was a calculus in the renal pelvis, the mucous membrane of which was thickly covered with papillary benign growths, which extended into the ureter one and one-half inches. There was no epithelial ingrowth into the wall of the ureter and renal pelvis. A stone caused hydronephrosis.

CASE 13. Busse's (23) case, a man 61 years old. Prof. Häckel extirpated the kidney tumor under great difficulties. The operation was apparently successful but the patient died four weeks later. He had an abscess in the lung, and also hæmorrhage. The wall of the renal pelvis was covered with small, wart-like elevations on the mucous membrane with broad base or thin thread-like pedicle; similar ones were also present all over the mucous membrane of the ureter, thickest near its orifice into the bladder, where a tumor the size of a hen's egg was found. There was a similar tumor in the bladder near the orifice of the right ureter and two smaller ones near the large tumor. That this was a benign tumor is known from the histological formation of the tumor, also from the patient's history. The suffering could be traced to twenty years.

CASE 14. Knowsley Thornton's (24) case of a woman 32 years old. She is said to have suffered with pain in the right renal region since she was eight years old. Nine years before admission to the hospital she had occasional attacks of hæmaturia. During the last few months a tumor in the right side of the abdomen had become very painful. She had a cystic kidney. Nephrectomy was performed and the patient was up on the 22d day. The specimen is unique; the ureter is surrounded at the exit from the kidney by a papillary growth the size of a pea. It is capped by an olive-shaped dark-brown calculus. The openings from the calices into the renal pelvis are dilated, two are blocked by these smaller brown calculi. The patient made good recovery. Stüsser (25) in his report of the case classes it among the benign. He said that upon examination of the specimen it was found that there was a villous new growth which extended from the mucous membrane of the renal pelvis at the beginning of the ureter and in other parts of the renal pelvis. There was no histological description of the papilloma and nothing more is known of the case.

CASE 15. Murchison's (26) case in a man aged 65 years. The patient had frequent hæmorrhage and pain. Other complications set in and the patient died. At the autopsy it was found that the

base and surrounding of both ureters, especially the right, were studded with long, delicate, villous processes, not forming a distinct tumor. The ureter and pelvis of both kidneys were enlarged. The mucous lining of the ureter was free. The case was diagnosed as villous disease of the bladder. In the kidneys the same morbid processes had begun. Stüsser (27) classes this case among the benign and adds that at the autopsy it was found that both renal pelves were covered with long, villous tumors and that in the lower part of both ureters kidney concretions were found.

CASE 16. Fenwick's (28) case of a man 70 years old, whose right kidney was removed on account of papillary growths in the renal pelvis and calices. He had suffered with hæmorrhage almost constantly for two years. At the end of the next year, a recurrence was noted in the right ureter and this was removed. Watson and Cunningham (29) in their report of the case state that the patient died uræmic four years later, and that toward the end there was carcinoma of the prostate and squamous-cell cancer, affecting the nephrectomy scar.

CASE 17. Picot (30) has recently reported a case of a man 53 years old who was brought to the hospital March 26, 1912. Seven years ago he had two hæmorrhages, the following year five or six attacks and lately they had become more frequent and lasted longer. He also complained of continuous pain on the left side. The diagnosis based on a cystoscopic examination was: three tumors of the renal pelvis with secondary transplantation in the bladder. Nephro-ureterectomy was performed. The ureter showed neoplastic infiltration and also two tumors having the same characteristics as those in the renal pelvis. All these papillary tumors macroscopically had the same aspect as the vesical tumors recognized by the cystoscope. The patient stood the operation well and returned home May 11th.

CASE 18. Israel's (31) case. Israel reports a case of a villous growth on the mucous membrane of the renal pelvis. Near the entrance to the bladder a new growth could be seen which covered the last 3 cm. of the ureter. The patient, a man 51 years old, had a severe hæmorrhage four years ago. Since then the attacks have been more frequent but less severe. He did not complain of pain nor colic, but by palpation it was felt that the kidney was enlarged. Retention of urine and the hæmorrhages had caused hæmatonephrosis. Nephro-ureterectomy was performed.

## BIBLIOGRAPHY


1. WATSON and CUNNINGHAM. Genito-Urinary Diseases, 1908, ii, 261.
2. STÜSSER. Beitr. z. klin. Chir., 1912, lxxx, 563.
3. WATSON and CUNNINGHAM. Genito-Urinary Diseases, 1908, ii, 261.
4. CUMSTON. Am. J. Urol., 1913, ix, 21.
5. STÜSSER. Beitr. z. klin. Chir., 1912, lxxx, 563.
6. Ibid.
7. WATSON and CUNNINGHAM. Genito-Urinary Diseases, 1908, ii, 264.
8. BUSSE. Virchow's Arch., 1901, clxiv, 119.
9. KOHLHARDT. Virchow's Arch., 1897, cxlviii, 565.
10. STÜSSER. Beitr. z. klin. Chir., 1912, lxxx, 563.
11. POLL. Beitr. z. klin. Chir., 1899, xxiii, 822.
12. RAUSCHENBUSCH. Inaugural Dissertation, Halle, 1882.
13. STÜSSER. Beitr. z. klin Chir., 1912, lxxx, 563.
14. DREW. Tr. Path. Soc. Lond., 1897, xlviii, 130.
15. MORRIS. Surgical Diseases of Kidney and Ureter, 1901, ii, 1.
16. STÜSSER. Beitr. z. klin. Chir., 1912, lxxx, 563.
17. Ibid.
18. Ibid.
19. Zentralbl. f. Chir., 1909, xxxvi, 654.
20. SAVORY and NASH. Lancet, Lond., 1904, ii, 1699.
21. STÜSSER. Beitr. z. klin. Chir., 1912, lxxx, 563.
22. BRADFORD. Tr. Path. Soc. Lond., 1898, 171.
23. BUSSE. Virchow's Arch., 1901, clxiv, 119.
24. KNOWSLEY THORNTON. Tr. Path. Soc. Lond., 1885, xxxvi, 269.
25. STÜSSER. Beitr. z. klin. Chir., 1912, lxxx, 563.
26. MURCHISON. Tr. Path. Soc. Lond., 1870, xxi, 241.
27. STÜSSER. Beitr. z. klin. Chir., 1912, lxxx, 563.
28. FENWICK. Tr. Med. Soc. Lond., 1897, xx, 237.
29. WATSON and CUNNINGHAM. Genito-Urinary Diseases, 1908, ii, 266.
30. J. d'urol., 1912, ii, 699.
31. Berl. klin. Wchnschr., 1901, xxxviii, 655.

# THE FUNCTION OF THE PERIOSTEUM IN BONE TRANSPLANTS, BASED ON FOUR HUMAN TRANSPLANTATIONS WITHOUT PERIOSTEUM, AND SOME ANIMAL EXPERIMENTS[1]

By CLARENCE A. McWILLIAMS, M. D., New York City

THOROUGHLY to appreciate some of the questions involved in the subject of bone transplantation, it will be necessary to consider briefly the three different views of recognized authorities as to the manner of regeneration of a graft.

1. The universally accepted view in Germany is that of Axhausen, who maintains that the bone in a graft always dies, is absorbed and is reformed from the periosteum, which alone remains living in transplants.

2. The second view is that of Macewen of Glasgow, who says that the bone in a graft is reproduced from the proliferation of osteoblasts, derived from the osteoblasts within the bone of the graft itself, and its regeneration takes place independently of the periosteum, whose only function is that of a limiting membrane, which prevents the spread of the osteoblasts into the surrounding tissues.

3. The third view is that of Murphy, who says that the graft is not osteogenetic but simply osteoconductive. Provided that it be in contact at one or both extremities with other living bone, the graft acts simply as a scaffolding for the growth of the capillaries with their osteogenetic cells as they advance from the living, contacting extremities into the graft. The periosteum takes no part in the actual reproduction of new bone. To analyze Dr. Murphy's transplantations a little further, I may say that I have gone through all of his reported transplantations with the object of finding out just what was done with the periosteum in each procedure. In a number of cases this was not stated. In all such instances I have ascertained from him in writing exactly what was done with the periosteum. In not a single instance did he omit to transplant grafts with more or less of their covering periosteum. From a practical point of view, I should judge that he does not know just what would have happened had he transplanted grafts without their periosteum, so that his conclusions as to the function of the periosteum are only conjectural.

The same may be said of Albee's work along this line. He agrees with Macewen and Murphy that the periosteum is unimportant so far as the life of the graft is concerned, yet, notwithstanding this view, he has never done a human transplantation without the periosteum, although he has performed 160 transplantations in all. It would strike the unprejudiced critic that the theories and practice of these men do not quite agree. Macewen and Albee have argued that, because they did not consistently obtain bone as a result of transplanting periosteum alone, consequently the periosteum has little function when it is left attached to grafts. Early in my work along this line it struck me that the proper angle from which to view this question of the function of periosteum could be obtained only from transplanting grafts of various sizes with and without their periosteum, since this is exactly what we do in our human transplantations. We do not transplant periosteum alone. The former is precisely what I have done and I think that I have definitely and conclusively proved, as you will later see, that the periosteum has a very important function in maintaining the nutrition of the graft.

When I looked over the results in a general way of both my animal and human transplantations, at first sight many of them seemed contradictory. On further analysis, however, it appeared as though all of these contradictions could be readily explained if we looked at it in this light: The life of a living graft, whether transplanted in the human

[1] Read in the Section on Surgery, American Medical Association Minneapolis, June 1913. From the Surgical Research Laboratory of Columbia University.

Fig. 1. Case 1. Rib grafted into a defect in lower jaw. A, rib.

being or in animals, whether transplanted with or without its periosteum, is probably entirely dependent on its being supplied with sufficient blood to keep it alive. I am inclined to believe that this will be the solution of the many vexed, theoretical considerations of bone grafting, and will explain the apparent contradictions and varying results obtained in bone transplantations. To particularize further, practically every bone graft made with its covering periosteum will live and grow if asepsis be attained. The question is, What will happen to grafts without their periosteum? The answer that I have obtained from my work along this line is this: The life of a graft without periosteum will depend entirely on its blood-supply. If it obtains sufficient blood, then it will live and grow; if not, then it will die. A small graft without periosteum will have a better chance of getting sufficient blood to its cells than a large one without its periosteum; but in either case there is always some doubt as to whether the graft will live, if it be without its periosteum. The periosteum on a graft does one of two things, or possibly both, namely:

1. By its presence it so favorably influences the nutrition of the graft, that is,

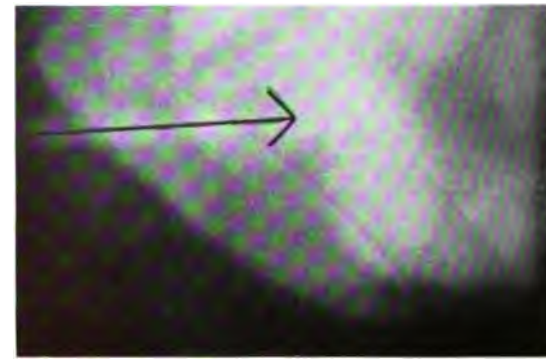


Fig. 2. Case 2. Rib grafted into inguinal hernia without periosteum.

increases the blood-supply to its cells, as to keep it alive, or

2. In case the bone cells in the graft die from insufficient nourishment, the periosteum supplies living cells to the graft, by means of which the bone is regenerated.

I can see no possible reason why the living cells in a graft should die if they be provided with sufficient blood. I hold this to be the function of the periosteum when attached to a graft. I hope to justify the soundness of my position in the illustrations.

### HUMAN TRANSPLANTATIONS

CASE 1. In November, 1910, I removed half the lower jaw from a lad of 12 for a large giant-cell sarcoma. Fifteen months later I grafted into the defect in the lower jaw a piece of rib which was entirely stripped of its periosteum. One end of the rib was beveled and this was sutured to the freshened edge of the remaining half of the jaw. The wound healed by primary union. Fig. 1 shows the rib in position. Five months later, a röntgenogram showed an entire disappearance of the grafted rib. There never was any discharge from the scar.

The result in this case is a contradiction of Dr. Murphy's second conclusion, that "bone, with or without the periosteum, transplanted in the same individual and contacted at one or both ends with other living, osteogenetic bone, always becomes united to the living fragment, and acts as a scaffolding for the reproduction of new bone."

Had I split the rib longitudinally so as to afford a better blood-supply to the bone-cells of the graft, it seems to me that it might have lived, or had I transplanted the rib with periosteum covering half its surface.

Fig. 3 K, Case 3. Fig. 3 P, Case 3.

Fig. 4 B, Case 4. Fig. 4 E, Case 4.

A, section for microscopic examination taken from tibia; B, section for microscopic examination taken from graft; C, graft.

CASE 2. The patient was a man, aged 32, into whose inguinal canal I transplanted a piece of a rib to strengthen a hernial repair. Fig. 2 shows the rib in position. A röntgenogram four months later, showed that the rib has entirely disappeared.

This case is corroborative of Dr. Murphy's conclusion that bone transplanted into muscle always dies and is ultimately absorbed. That this statement is not always true, however, will be seen later from some animal experiments. Had I split this rib likewise, I believe that the consequent better blood-supply to its cells would have kept it alive.

CASE 3. The patient was a man, aged 32, who had received a compound fracture of the left humerus, a month before he came under my care. He was operated on immediately after the accident in another institution and the fracture was wired. This was followed by violent sepsis. Two sequestra were picked out of the wound the next day after the man came under my care. The patient had a musculospiral paralysis, indicated by the wrist-drop. The result of the application of a Lane plate to the fracture, after sawing off the ends of the fragments, was still non-union.

Five months after the previous plating, on account of non-union, I grafted into the medullary cavities of the fragments, which were first reamed out, a section from a subperiosteally resected rib. After the rib was in position, there was some side-to-side rocking of the fragments on each other, due to the fact that the rib was evidently a trifle too short. On this account I applied a Lane plate. It was then thought best to unite the divided musculospiral nerve. The ends were dissected out and it was found that there was a defect of an inch and a half to be bridged over. This was accomplished by cutting out of the distal extremity a segment, which was turned up to meet the proximal end, to whose freshened edge it was sutured with chromic gut. The result of this bone grafting was very disappointing. A picture (Fig. 3 K) after nine months showed no proliferation whatsoever of its bone and there was no better union than at the time of the grafting.

That the musculospiral nerve was regenerating was shown by the fact that sensation had returned in the distribution of the nerve, although there was no motor power as yet. Nine months after the rib grafting, I removed (Fig. 3 K) the remains of the grafted rib. A section of it under the microscope showed that it was undergoing rarefying osteitis and that it consisted mostly of dense fibrous tissue with scattered areas of bone. The medullary cavities of the fragments were reamed out (Fig. 3 P), and into them was inserted a graft, taken from the front of the tibia with periosteum on two of its sides. A nail was inserted in its upper end to prevent its riding up into the medullary cavity.

The result of this grafting was unfortunate. There was infection of the wound, requiring the removal of the nail and the dead graft. So that his condition was not improved.

CASE 4. This is an exceedingly interesting case of non-union in a birth fracture of both bones of the

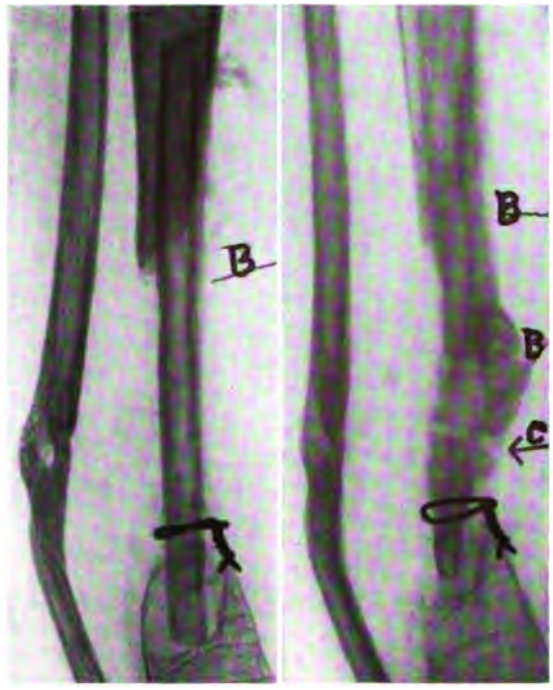



Fig. 4 I, Case 4. B, new bone in a thin plate along periosteum. Taken two months after operation, shows beginning new bone being formed.

Fig. 4 K, Case 4. B. new bone from periosteum; C, fracture.

leg in a child, aged 17 months. The non-union I attributed to insufficient immobilization of the leg. I cut down on the fracture and, after freshening the pointed extremities of the fragments, there resulted a defect of an inch and a half in the tibia, which made transplantation of bone necessary. A graft from the opposite tibia was chiseled out with its periosteum attached. The periosteum was then deliberately peeled off the graft with the object of confirming Macewen's view of its unimportance. One end of the graft was pointed and it was wedged into the medullary cavity of the upper fragment, and the lower side of the transplant was spliced to the side of the lower fragment with chromic gut. The subsequent union of the wound was by first intention. Fig. 4 B shows the condition six months after the grafting. It was very disappointing to see the tibial graft gradually melt away in the tissues, so that, after six months, it was not more than one quarter its original size. Since union was by first intention, there seems no way of accounting for the death of the graft save on the basis of a lack of periosteum, or of a deficient blood-supply, or both. Fig. 4 E shows the condition six months after the previous grafting operation, at which time I transplanted 5 inches of the opposite, healthy fibula into the medullary cavities of the fragments, as seen. It was transplanted with the periosteum covering its entire circumference, and this was not split in the slightest. The result shows that this splitting of the periosteum on the graft is entirely unnecessary and accomplishes nothing. Below, a wire-encircling suture was used to hold the graft in place. On the right one sees the defect made in the fibula. Fig. 4 I shows new bone being formed along the periosteum of the fibula graft, as a thin plate, two months after grafting.

Fig. 4 K was taken six months after the transplantation. To my mind it seems to imply the necessity of revising Dr. Murphy's conclusion that a graft is not osteogenetic in itself. A fracture has taken place in the mid-third of the transplant, due to the fact that the child kicked off the splint one night. We see that this fracture of the graft itself is consolidating nicely under an enormous callus. If we accept Dr. Murphy's conclusion, we must believe that all this callus came through the graft from the contacting old bone of the neighboring stumps.

I do not accept this view for a moment, but believe that the callus arose either from the periosteum or from the bone of the graft itself. Along the outer surface of the graft we see at least a quarter of an inch of new bone evenly distributed. Were this new bone formed from the contacting ends of the old bone of the stumps, it seems to me that it would shade off, becoming less the farther we went from the old bone. As a matter of fact, the greatest amount of new bone is at the fracture spot in the graft, which is at some distance from either contacting extremity of old bone. Fig. 4 K shows that the transplant (June 9, seven months after the grafting) has continued to develop. The upper part of the graft has become as large as the opposite healthy tibia. The fragments below the fracture, due to the inhibitory influence of the wire, have not well developed. In addition the wire is eroding the bone of the graft. I removed this wire June 14, 1913, with the object of preventing the cutting through of the graft.

Fig. 4 M shows that, six months after the transplantation, there is no filling in of the defect in the fibula with new bone since all the periosteum was removed with the graft. To have new bone fill up a defect it is absolutely necessary to leave either some bone or else some periosteum in place bridging the defect.

Fig. 4 P shows the result two months after the removal of the wire. The lower fragment which was being eroded by the wire has markedly developed and the fracture is consolidating nicely.

At the recent surgical congress in New York, Dr. Murphy said, "In bone transplantations there is but one absolute essential, other than rigid asepsis, and that is that the bone graft must be closely connected at some one point at least with living, freshened, osteogenetic tissue." From the preceding human transplantations, I judge that there is one other essential, and that is the presence of the periosteum.

ANIMAL EXPERIMENTS

Experiment 2. Fig. 6 shows the condition six months after the resection of the whole diameter of a rib together with its periosteum. The defect has not at all closed in. The periosteum was stripped bluntly from the bone section and this strip of periosteum was transplanted into the abdomen.

Result: A transverse section was cut six months later through this periosteum, which was felt to be bone. A photomicrograph of this section gives a picture of normal, healthy, living bone surrounded by a closely investing connective-tissue capsule. There are no osteoclasts present nor any round cells suggestive of either a destructive or an inflammatory process. I shall not go into a description of these microscopic sections but shall give you simply the results of them. This result shows that transplanted periosteum may produce living bone.

Experiment 3. This animal was killed eight months after the subperiosteal resection of a section of a rib (Fig. 7 A). This rib without periosteum was then split into longitudinal strips and these were transplanted into the abdomen.

Result: The defect in the rib from which the periosteum was not removed has become entirely filled in with new bone (Fig. 7 A). The strips transplanted into the abdomen have remained intact, have grown together, and have increased in size. A photomicrograph of a section of this abdominal transplanted bone shows bone perfectly alive, not undergoing absorption, and containing well-preserved and normal marrow. I attribute the living of these transplants to the fact that the splitting of the original rib allowed sufficient blood to get to the bone-cells.

This and the following experiment are refutations of Dr. Murphy's conclusion, in which he says that bone, with or without its periosteum, when transplanted into the soft parts and not in contact with living bone, always becomes absorbed.

Experiment 4. This dog was killed six months after subperiosteal resection of two ribs. The ribs without periosteum were broken up with the rongeur into the smallest possible fragments and these were transplanted into the abdomen.

Result: The defects made in the two ribs have acted differently one from the other (Fig. 8 A). The upper defect has about half filled in with new bone while the lower has formed a complete new rib, almost double its normal size. The fragments (Fig. 8 B) into the abdomen have lived, have increased in size, and have amalgamated into one homogeneous piece. A photomicrograph of a section, taken from these abdominal grafts, shows that the graft is perfectly alive, and contains normal marrow and normal blood-vessels. There are no osteoclasts present nor any signs of a destructive or degenerative process.

Fig. 4 M, Case 4. Fig. 4 P, Case 4.

The last two experiments clearly demonstrate that the life of a living graft depends entirely on its receiving sufficient blood to keep it alive, and nothing else. This was made possible by the splitting of the grafts which allowed sufficient blood to get to their cells. The next two pictures more clearly bring this point out, both being the same experiment.

Experiment 5. In this animal, killed after one month, two ribs were subperiosteally resected. One of the ribs was transplanted into the abdomen, into a defect made in the last rib, after the periosteum of the last rib was divided and separated but not removed. The second rib, also without its periosteum, was sutured to the end of the first rib, and both ribs in contact were buried in the abdomen.

Result: The first rib (Fig. 9 A) has healed in perfectly to the defect made in the last rib by a massive callus formed at the point of junction, evidently due to periosteal bony growth. There is no union or new bone formed whatsoever between the two transplanted ribs, owing, as I believe, to an

Fig. 6. Experiment 2. A, resected rib; B, periosteum with new formation of bone after six months, three weeks transplanted into the abdomen; C, transverse section for microscopical examination.

insufficient blood-supply to their cells and to the absence of periosteum to re-form the bone. In addition, the second rib shows beginning absorption, evidenced by its honeycombed appearance. The picture indicates that an entire graft on an entire graft, neither having any periosteum, will not live.

Experiment 6. This is the same experiment as the preceding. The animal was killed six months after four ribs were resected without their periosteum. One of the ribs without periosteum was sutured to a defect in the last rib, a second rib was sutured to the end of the first, and both ribs were buried in the abdomen. Fragments from another rib, which was divided into as small pieces as possible, were strewn along both the transplanted ribs.

Result: Fig. 10 shows that all the four defects created in the ribs have become completely filled in with new bone, owing undoubtedly to the presence of the periosteum, which had not been removed. The picture further shows that the second attached rib, as well as about half the first rib, have become entirely absorbed. Some of the fragments have become attached to the sides of the remaining part of the first rib.

The last four experiments are a convincing demonstration, it seems to me, of the fact that it is simply and solely a question of a sufficient blood-supply, which determines whether a graft will live or die, and not a question of whether the graft be in contact with living bone or not, as Dr. Murphy maintains.

Experiment 9. This animal was killed five months after one inch of the radius, together with its periosteum, was removed. The periosteum was then scraped off the fragment, which was split into as small pieces as possible with the rongeur. These small fragments were replaced, filling in the defect in the radius.

Result: The small fragments (Fig. 13) have all remained alive and have coalesced into one piece,

Fig. 7 A, Experiment 3. Middle of left rectus, sheath divided and strips laid on muscle, separated from each other, sheath sutured over these. Picture shows rib entirely reformed and growth together of bones in abdomen.

which has become united to the ends of the radius fragments.

This experiment illustrates the influence of a good blood-supply on grafts.

Experiment 12. This dog was killed twenty-four days after the periosteum was excised from a wide area of the humerus. Within this area was chiseled away a section of bone, extending into the medullary cavity, and the marrow and endosteum were thoroughly curetted away.

Result: Fig. 16 shows that the cavity made in the bone is irregularly filled in by new bone, the medullary cavity being quite obliterated by this newly formed bone. The periosteum can be seen ending at quite a distance from this cavity, and by no stretch of the imagination can one think that it had anything to do with the formation of new bone. Likewise with the endosteum. The new bone must then come from the bone-cortex itself, resulting from the efficient blood-supply from the nutrient artery. From these cases and experiments, we see that to have new bone fill in a defect it is necessary to have either some periosteum covering it or else at least a thin layer of bone bridging over the defect.

Experiment 13. The last statement made is exemplified in this animal, which was killed six months after the removal of an inch and a half from the radius, together with its periosteum. The animal was killed because he fractured the ulna, immediately opposite the defect in the radius.

Result: Fig. 17 shows that there has not been the slightest attempt to fill in the defect in the radius with new bone, owing, as I believe, to there being no periosteum left to produce it. If Macewen and Murphy are right in their views, why was this defect not filled in with bone coming from the ends of the fragments?

Experiment 14. This animal was killed three months after the removal of two inches of bone from two ribs, each with its corresponding periosteum. Each single fragment was transplanted into the defect made by the removal of the other fragment, each being completely covered by its periosteum. They were both held in place, end to end, by sutures

Fig. 8 A. Fig. 8 B.

Fig. 8 A. Experiment 4. Two ribs subperiosteally resected. Shows perfect reformation of one rib and imperfect reformation of other.

Fig. 8 B. A, section for microscopical examination; B, new bone.

passed through drill-holes in their extremities and through drill-holes in the ends of the fixed ribs.

Result: One end (Fig. 18) of each graft has not united to its corresponding extremity of the rib, owing to the respiratory motions. The other ends are solidly united to the fixed rib. In addition there is irregular production of new bone at various points on the grafts, due to periosteal growths. This result shows the great influence the periosteum exerts in preserving the life of grafts. Microscopic sections of each of these transplants show that they are both actively alive.

Experiment 15. This animal died six weeks after 2½ inches were resected from each fibula with the periosteum attached. Into the right fibula defect was transplanted the left fibula graft without any of its periosteum, the transplant being first divided into six fragments. Into the left fibula defect was transplanted the right fibula graft, which was previously divided into six fragments, on each of which was left its corresponding periosteum.

Result: The fragments without periosteum (Fig. 19) into the right fibula defect have become almost entirely absorbed. There is just a faint line indicating the little that remains of the grafts. In startling contrast to this is the result in the left leg, into which defect the fragments were transplanted with the periosteum on each fragment. These individual grafts have not been absorbed in the slightest; on the contrary, they have grown together and have increased in size. It is not possible to escape the conclusion that this good result in the left leg is entirely and absolutely due to the presence of the periosteum. If the result depended simply on the contact with the neighboring, living bone of the stumps, as Murphy maintains, why did not the fragments without periosteum in the right leg live?

Experiment 16. Fig. 20 shows the condition eight months after sections were taken from each fibula, from each of which the periosteum was carefully scraped. Into the left fibula defect was transplanted the entire, undivided, right fibula fragment without periosteum in contact with the ends of the living stumps. Into the right fibula defect was transplanted the left fibula fragment without periosteum, which was first divided into two longitudinal

Fig. 9 A, Experiment 5. The two transplants are shown, the upright or second transverse rib shows beginning absorption and also the absence of union between it and the adjacent transplant. The first transplanted rib shows an excessive callus and solid union due to periosteum.

strips, these being placed side by side in contact with the ends of the living stumps.

Result: The two fragments without periosteum (Fig. 20), comprising the graft into the right fibula defect, have lived perfectly and have united together and to the ends of the old stumps. In addition there is proliferation of new bone, uniting the graft to the neighboring tibia. In contrast to this is the result in the left defect. This graft without periosteum, transplanted entire, has very poorly united to the ends of the old stumps, and the transplant appears, from its poor shadow and irregular honeycombed appearance, to be absorbing. I attribute this difference in the result to the fact that the splitting of the graft allowed a much better blood-supply to reach the bone-cells of this graft than was possible in the case of the graft which was not split.

Experiment 17. Fig. 21 is very instructive and illuminating, and warrants close study. It was taken eight months after sections of bone were taken with the periosteum from each fibula. Into the left fibula defect was transplanted the right fibula graft, which was first broken up into the smallest possible pieces, the periosteum being thoroughly scraped from the small fragments. The pieces completely filled in the defect and were in contact with the ends of the stumps of the old bone. Into the right fibula defect were transplanted fragments of the left fibula graft with periosteum still attached to each small graft.

Result: Fig. 21 indicates the great value of having periosteum on grafts. The small fragments without periosteum in the left defect have become largely absorbed, being much reduced in number. Those which remain are isolated, are not united, and appear to be absorbing. In marked contrast to these are the fragments transplanted into the right defect with periosteum. They have become united to each other in most instances, have increased in size and produce the deep shadows of healthy, living bone.

This experiment is another instance of the fact that contact with living bone does not

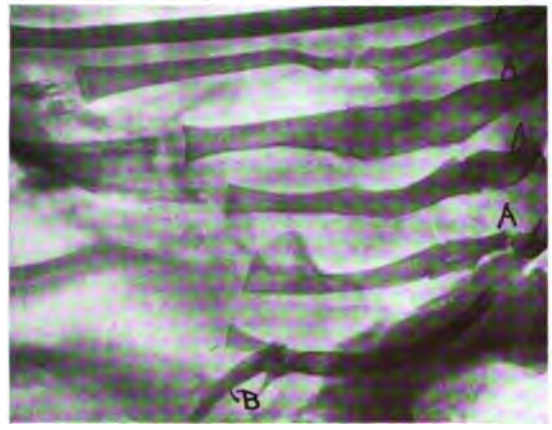



Fig. 10. Experiment 6. A, four resected ribs all filled in. Removed without periosteum. B, transplanted rib all that is left of two grafts. Section from this spot for microscopic examination.

seem to be the important element which Dr. Murphy has attributed to it. This experiment is a further proof of the statement, emphasized by me, that without periosteum there is always uncertainty as to whether grafts, even though they be small, will acquire enough blood to keep them alive. With the periosteum on the grafts one is sure of their living, I believe, as the result of one or two things happening: either a sufficient blood-supply, or a resupply to the grafts of living cells, derived from the periosteum, which reproduce the bone.

Experiment 18. A transplantation, in which, into a defect made in the left fibula, were transplanted fragments obtained from the right fibula, each covered with its periosteum. Into the right fibula defect were transplanted fragments from the left fibula section, from which all the periosteum was first carefully scraped away.

Result: The result in this dog confirmed the view that the life of grafts depends simply and solely on the blood-supply which they obtain. The fragments with periosteum into the left fibula defect appear to have lived perfectly, to have increased in size, and to have solidly united with each other and to the ends of the old, living stumps. The same process occurred on the right side, into which defect fragments without periosteum were transplanted.

Experiment 19. In this experiment into a defect made in the left fibula were grafted fragments, taken from a section of the right fibula, from which all the periosteum was first carefully scraped away. Into the defect made in the right fibula were transplanted fragments with periosteum on each piece, taken from a section of the left fibula.

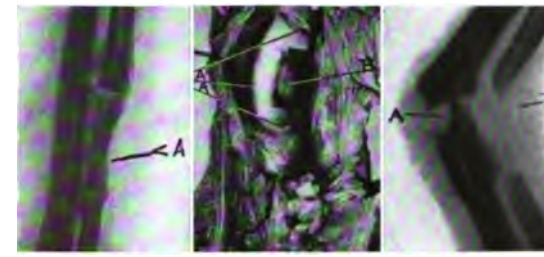



Fig. 13. Fig. 16. Fig 17.

Fig. 13, Experiment 9. A, pieces of graft.

Fig. 16, Experiment 12. A, edge of periosteum; B, new bone.

Fig. 17, Experiment 13. A, fracture; B, defect in bone not filled in because of removal of periosteum with the bone.

Result: The fragments transplanted without periosteum into the left fibular defect have almost completely disappeared. The fragments transplanted into the right defect with periosteum have remained living, have markedly increased in size, and have largely united to each other and to the ends of the old stumps. The feature to be particularly noticed in this picture is the pronounced increase in size of the right-sided grafts, denoting the active life of the transplants, and also the fact that, although the middle section of the graft on the right side does not seem firmly united to the neighboring transplants, yet this middle section appears to be as actively alive as the sections which are in intimate contact with the ends of the old stumps; all of which goes to show that contact with living, old bone has not the influence on the subsequent life of grafts that Dr. Murphy has attributed to it. Far more, as I have repeatedly tried to emphasize, do I believe that it is solely a question of sufficient blood getting into the graft.

The accompanying two tables give the results obtained in all of these transplantations.

From Table I it may be seen that 93 per cent of all transplantations made with the periosteum were successful, while but 48 per cent of those made without the periosteum were successful.

TABLE I.—RESULTS OF GRAFTS WITH AND WITHOUT PERIOSTEUM

| | | | Totals | |
|---|---|---|---|---|
| With— | Animal | Human | No. | Per Cent. |
| Successful | 13 | 1 | 14 | 93.3 |
| Unsuccessful | 1 | 0 | 1 | 6.7 |
| Without— | | | | |
| Successful | 12 | 0 | 12 | 48 |
| Unsuccessful | 9 | 4 | 13 | 52 |

TABLE II.—GRAFTS WITHOUT PERIOSTEUM: RESULTS OBTAINED IN TRANSPLANTATIONS WITHOUT THE PERIOSTEUM ACCORDING TO THE SIZE OF THE GRAFTS

| | | | Totals | |
|---|---|---|---|---|
| Small fragments — | Animal | Human | No. | Per Cent. |
| Successful | 7 | 0 | 7 | 50 |
| Unsuccessful | 7 | 0 | 7 | 50 |
| Larger, single grafts— | | | | |
| Successful | 5 | 0 | 5 | 41 |
| Unsuccessful | 3 | 4 | 7 | 59 |

From Table I it is seen that 48 per cent of all the transplantations made without periosteum were successful. From this I reason that there must be some other factor present, making for the success of these grafts, than the mere covering of the periosteum, and this I infer must be the presence of a sufficient blood-supply to keep them alive. Had the periosteum been on the grafts, it may be safely said that they would practically all have survived. Just exactly what the influence is which the periosteum exerts, it seems difficult to state positively. Whether its presence affords a better blood-supply to the grafts, or whether the periosteum, in the event that the bone-cells in grafts have died, supplies fresh cells to the grafts and from these regeneration takes place, must for the present remain unsettled. That the blood-supply is more than likely the important point is seen from Table II. It goes without saying that a small fragment will get a sufficient blood-supply to its cells more readily than a single, large piece, hence is more likely to remain living. This important fact is proved in Table II, in which it is shown that 50 per cent of the transplantations in which small fragments without periosteum were grafted were successful, while but 41 per cent of the transplantations in which single, larger pieces without periosteum were grafted were successful.

I think, in conclusion, that I have demonstrated that both Macewen and Murphy are mistaken in their conception of the lack of function of the periosteum in maintaining the life of grafts. It seems to me likewise that Murphy is misled in his conception that the graft is not osteogenetic in itself. This fact is clearly seen in Experiments 3, 4, 17 and 19. He says that the graft is simply osteoconductive of cells into the graft from the contacting extremities of the neighboring old bone. If this be the case, why should so many of the grafts without periosteum have died in which this contact was thoroughly carried out?

## CONCLUSIONS

The conclusions from the preceding human transplantations and animal experiments are:

1. If the periosteum be excised from an area of bone and a section of bone within this area, going into the medullary cavity, be removed (not, however, involving the whole diameter of the bone) and the endosteum scraped away as well, then it is found that the cavity fills in perfectly with new bone, which of necessity must come from the old bone alone. This is probably due to the fact that the nutrient artery is intact.

Proofs: Human transplantation, Case 4, in which the defect in the tibia filled in perfectly; Animal Experiment 12.

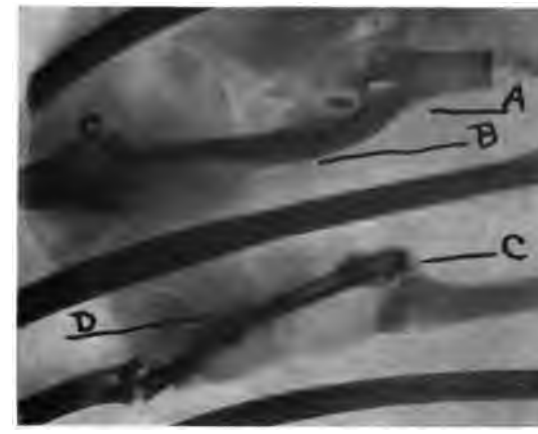



Fig. 18, Experiment 14. A, solid union here; B, section taken for microscopic examination; C, no union due to respiratory motions of chest, notice periosteal outgrowths; D, section taken for microscopic examination. Union here.

2. If a section of the whole diameter of a bone be removed, then the bone will regenerate between the ends of the fragments if the whole or a part of the periosteum be preserved bridging the defect.

Proofs: Animal Experiments 3, 4 and 6; Bashkirzew's human case (see my Conclusion 6). The subsequent reformation of the ribs after human empyema operations performed subperiosteally.

3. If a section of the whole diameter of a bone be removed, very little subsequent filling in of this defect by bone will take place if the entire periosteum has been removed from between the ends of the fragments.

Proofs: Animal Experiments 1, 2, 13, 15 (right), 17 (left), 19 (left) and 20 (left). Human transplantation, Case 4, in which a great part of the fibula with all its periosteum was removed. There is very little of this shaft which has been reformed. In case that we wish to have a bone reform, it seems necessary to leave some of its periosteum in position.

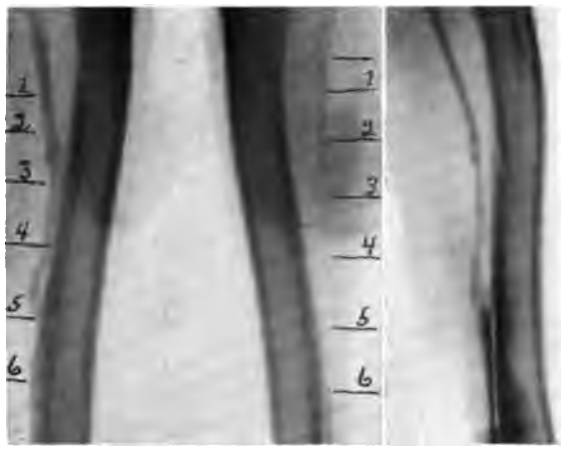



Fig. 19, Experiment 15. Points of section.

Fig. 20, Experiment 16.

Fig. 21, Experiment 17.

This is brought out by Frangenheim[1] and von Hacker.[2] They each took pieces from the fibula, comprising the whole thickness of the bone together with all the periosteum covering these fragments. There was no subsequent reformation of bone in the defects. Frangenheim consequently recommends that in taking a section from the fibula, a small strip of periosteum, from which the fibula will be reformed, be left on the interosseous membrane.

4. Provided a graft be living and taken from the same patient, its future life depends on an efficient blood-supply, irrespective of the periosteum or whether it is in contact with living bone or not. This conclusion I wish to emphasize strongly.

Proofs: Animal Experiments 3, 4, 8, 16 and 18.

5. If minute fragments of a living graft be transplanted, then the periosteum may be disregarded because the osteoblasts in the fragments may not die because of an easy access of blood into them, and the pieces may grow and coalesce and not become absorbed. My statistics show that 50 per cent of such transplantations will be successful.

Proofs: Animal Experiments 7, 9, 16 and 18, also Macewen's human case. Thus, in his book he narrates the case of a boy, the whole of the diaphysis of whose humerus he was compelled to remove for necrosis. There was no subsequent osseous deposition. Fifteen months later, two wedges of bone were excised from another patient 6 years of age, affected with anterior curves. These were cut into minute fragments, quite irrespective of the periosteum, and were then deposited in the muscular sulcus in the boy's arm. Two months later, a portion of new bone, an inch in length and three-quarters of an inch in thickness, was found firmly attached to the upper fragment of the humerus. Here all the grafts proliferated, grew to one another and also to the extremity of the proximal portion. Two other wedges of bone of larger size than the first and broken up into fragments were similarly dealt with and inserted two months subsequently to the first graft, and a third couple were placed in position five months after the first. These all fused together and to the condyles of the humerus and filled the gap in the arm to the extent of 4 inches. It is now thirty years since the shaft of the humerus was rebuilt, and, during that period, the man has depended on his physical exertions for his livelihood. He is now an engineer's pattern-maker. Other cases in which minute fragments of bone have been successfully transplanted are on record. Thus, Vallas[3] reported the case of a woman on whom he had operated five months previously for a pseudo-arthrosis of the tibia. At the operation, he found that the ends of the fragments touched at only a small point, due to the slender form of the inferior fragment. He then removed from the rounded extremity of the upper segment ten or twelve bony chips which he placed in the defect between the bones. The periosteum and soft parts were then sutured about these chips. Primary union resulted and in six weeks consolidation was complete and the patient left the hospital. Barth[4] reports two successful cases in each of which he transplanted two fragments, taken from the tibiæ, each covered by periosteum. In both of these cases, the fragments grew and proliferated and filled in the defects perfectly. Even though one is safer in transplanting small fragments without the periosteum than larger ones (compare Experiments Nos. 16 and 18), at the same time the

[1] Fragenheim: Arch. f. klin. Chir., 1909, xc, 438.

[2] Von Hacker: Quoted by Streissler, Beitr. z. klin. Chir., 1910, lxxi, Part 1.

[3] Vallas: Lyon méd., 1894, lxxvii, 606.

[4] Barth: Arch. f. klin. Chir., 1908, lxxxvi, 860.

small fragments may die if they are without the periosteum (compare Experiments Nos. 15, 17, 19 and 20).

6. If a larger piece of living bone be transplanted, then it is safer to leave the periosteum attached to the graft to assure its future reformation, since otherwise the osteoblasts in the bone of the graft may die because cut off from their nutrient artery. The periosteum survives because of its sufficient blood-supply from the surrounding tissues, its inner surface forms osteoblasts which themselves proceed to reform the bone of the graft, in the event that the osteoblasts within this have died from a deficient blood-supply. My statistics show that 41 per cent of transplantations are successful in which large grafts without periosteum are grafted.

Proofs: Previous Cases (human) 1, 2, 3 and 4; Animal Experiment 14. For the sake of being explicit, I wish to state that this conclusion does not imply that the periosteum is unconditionally necessary for the growth of transplanted bone. It merely asserts that one is much surer of the grafts living if the periosteum is present on the graft. There are comparatively few cases on record of grafts having been made without the periosteum. I presume that this is due to the fact that it is not customary to report non-successes. I have come across the following two cases which were successful after transplanting grafts without the periosteum: Baskirzew[1] reports a case which illustrates two things; first, how well the defect in a bone made by removing its entire diameter will fill in, provided the periosteum be left; and, second, how well a graft may live and grow at times even when transplanted without its periosteum. Thus, he removed a 9 cm. piece without its attached periosteum, from the diaphysis of a fibula for the purpose of a transplantation. Four years afterward, in the place where the fibula was removed, a stout, although uneven, fibula resulted. The piece from this fibula was transplanted in a defect made in the ulna for the removal of a supposed sarcoma in which not only the bone but also its periosteum was entirely removed. The graft in the ulna without periosteum, transplanted into a bed not lined by periosteum, grew in perfectly and consolidated with the upper fragment, a fact due, as I believe, to sufficient blood having been supplied. The second case is that by Wetherill.[2] On September 28, 1912, he grafted a segment, three and a third inches long, from the opposite tibia into a defect in the tibia resulting from osteomyelitis. The graft was taken without its periosteum. A röntgenogram taken after six months shows that the graft has lived and has increased n size.

7. A graft on a graft, neither having a covering periosteum, will not live, even though one graft be in contact with living bone.

Proofs: Animal Experiments 5 and 6.

8. Periosteum when transplanted alone into the soft parts may produce living bone.

Proof: Animal Experiment 2. The remarkable vitality of transplanted periosteum has been demonstrated by Grohe[3] and Morpurgo,[4] the former showing that it is capable of preservation for one hundred hours and yet able to be implanted and preserve its osteogenetic powers; the latter showing that the periosteum of a corpse, kept at 15° C., can produce new bone when transplanted after 168 hours.

9. The splitting of the periosteum of a graft, even though the transplant is entirely surrounded on all sides by periosteum, seems to be unneccessary and accomplishes nothing.

Proof: Previous Case 4 (human), in which the fibula graft was transplanted with periosteum on all its sides and this was unsplit. The graft grew beautifully.

10. Altogether sixteen transplantations with periosteum were performed and of these all but one (93 per cent) were successful.

11. Altogether twenty-five transplantations without periosteum were performed. Of these 48 per cent were successful (all in animals), while 52 per cent were unsuccessful. The influence of the blood-supply is demonstrated by the fact that 50 per cent of the transplantations without periosteum, made with minute fragments, were successful, while 41 per cent of those without periosteum, made with large, single fragments, were successful.

12. From a consideration of all the foregoing facts, the conclusion seems irresistible that bone-grafts of whatever size, in order that one should be positively assured of their subsequent living, should be transplanted with as much periosteum covering their surfaces as is possible.

I desire to thank Dr. Joseph Blake for the privileges of the laboratory, Dr. William C. Clark for the pathologic examinations, and Mr. Ira Simms, of the Presbyterian Hospital, for the excellent röntgenograms.

[1] Baskirzew: Deutsche Ztschr. f. Chir., 1912, cxiii, 524.

[2] Wetherill, H. G.: The Growth, the Death and the Regeneration of Bone. J. Am. M. Ass., 1913, March 29, p. 983.

[3] Grohe: Virchow's Arch. f. path. Anat., etc., Berl., 1899, clv, 428.

[4] Morpurgo: Virchow's Arch. f. path. Anat., etc., Berl., 1899, clvii, 172.

# THE SURGICAL TREATMENT OF INTRAMEDULLARY AFFECTIONS OF THE SPINAL CORD[1]

By CHARLES A. ELSBERG, M. D., New York City

WITH the increase in our knowledge of diseases of the spinal cord and its membranes, and the advance in our surgical methods, operations for affections of the cord have become increasingly frequent. Up to within the last few years, however, surgical interference in disease of the substance of the spinal cord was rarely, if ever, attempted. Seldom had anyone ventured to invade the delicate tissues of the cord, for fear of causing greater damage than that produced by the disease. Excepting in rare instances, such as Abbe's (1) attempt to empty a hydromelia cavity by aspiration, intramedullary cord affections were considered hopeless. If the diagnosis of intramedullary disease was made, operative interference was considered contra-indicated; if an affection of the cord itself was found at operation, the wound was closed without delay.

It was perhaps fortunate for the progress of spinal surgery that the differential diagnosis between intramedullary and extramedullary disease was often uncertain, that such signs as absence of pain and the dissociation of sensations were not always sufficient to permit a definite conclusion. Hence intramedullary affections were encountered in the course of spinal operations and the surgeon gained a better knowledge of the physical character of intramedullary spinal disease. Then followed isolated instances in which the surgeon ventured to invade the cord substance—Krause (2), Röpke (3), von Eiselsberg (4), Veraguth and Brun (5), Braun (6), Schultze (7), Elsberg and Beer (8), etc. These surgeons were cognizant of the dangers of manipulation of the cord, of the irreparable damage that might result from the slightest trauma, and the danger of transverse lesions from injury to the cord tissue; that in spite of this they ventured upon this unexplored field is another evidence of the restless forward march of scientific surgery.

All these efforts to attempt the surgical relief of affections within the substance of the cord were, however, only isolated efforts; they were not based upon regular, well worked out methods of procedure: they lacked a carefully worked out anatomical foundation and the necessary special technique.

During the past three years, I have made a study of the anatomy and physiology of the spinal cord from the viewpoint of intramedullary surgery, have attempted to develop a special technique, and have applied this technique to the operative treatment of some intramedullary diseases. The results of these investigations and experiences are herewith described.

## THE FREQUENCY OF INTRAMEDULLARY SPINAL DISEASES WHICH MIGHT BE SUBJECTED TO SURGICAL TREATMENT

Intramedullary tumors are not by any means as rare as they are believed to be by some authors. Thus Allen Starr (9), quoting from Schlesinger, states that among 302 tumors of the cord, 125 were within the cord substance. These included sarcoma, tuberculous tumors, gumma, glioma, lipoma, cysticercus, neuroma, cholesteatoma, myxoma, teratoma, adenoma, endothelioma, etc. Many of these intramedullary growths infiltrate the cord substance and increase in size by extending upward and downward, but some enlarge in their transverse diameter, are encapsulated and of small size. Gowers (10) says that "these tumors in some cases blend with the substance of the cord, but in other instances they are bounded by an area of softening which often isolates even invading growths." According to Flatau and Gowers, many tumors are sharply limited. Flatau (11) states that the comparative frequency of extramedullary and intramedullary tumors is as 2.6 to 1 (57 intramedullary tumors in 213 cases). Although one cannot estimate from the reports the frequency of localized and

[1] Read before the Section on Neuropathology of the XVIIth International Congress of Medicine, London, 1913.

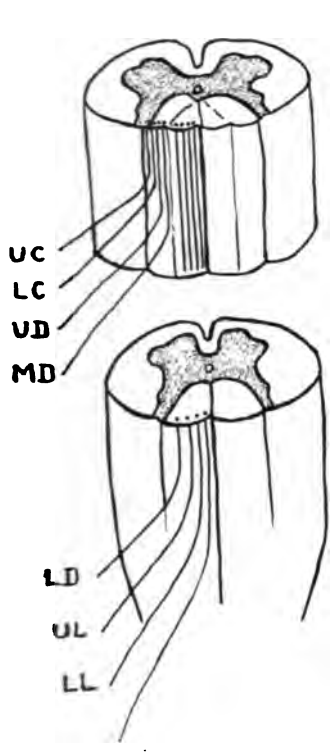



Fig. 1.

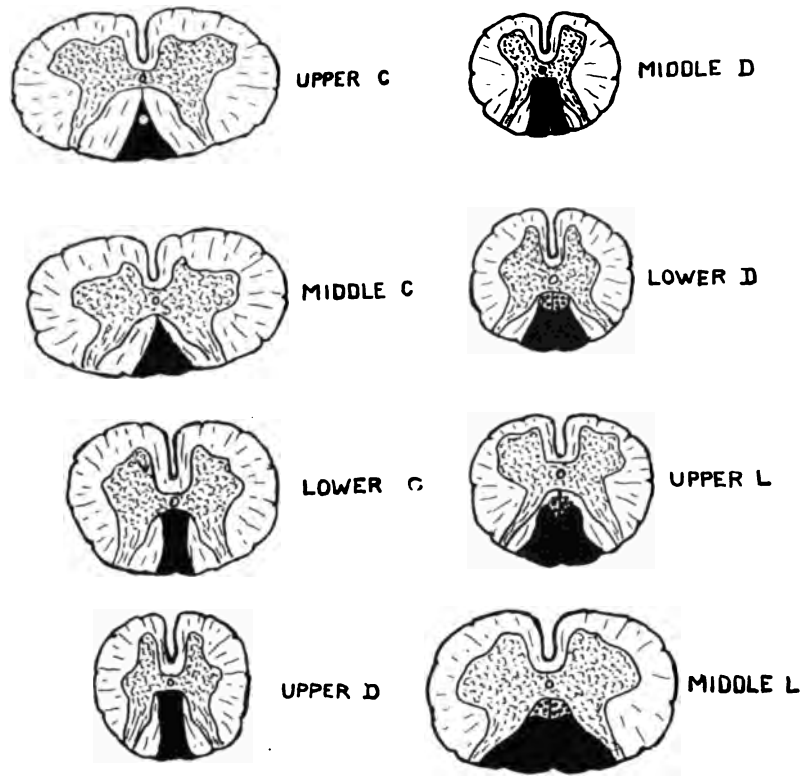



Fig. 2.

Fig. 1. The conducting paths in the posterior columns of the spinal cord, showing that the fibers from the sacral (S) and the lower lumbar (LL) posterior roots lie nearest the posterior median fissure (diagrammatic).

Fig. 2. The areas in the posterior columns in which ascending degeneration occurs after injury to the sacral and lower lumbar posterior roots of both sides (after Schultze). Within these areas, shaded in black, an incision can be made which will cause little injury and few, if any, symptoms.

encapsulated intramedullary growths, the fact that one frequently finds illustrations and descriptions of such tumors in the literature is evidence for the contention that they are not so very rare. Localized tumors have been found at operation by Krause, Röpke, Elsberg and Beer, and many others. Localized cysts have been found by Krause and myself. That localized collections of fluid occur in syringomyelia and hæmatomyelia quite often is well known. Foreign bodies have been found lodged in the cord substance. In the instances cited, the affection of the cord is of such a nature that, physically at least, its removal or eradication should be possible.

Aside from these more strictly localized affections, there are others of a more diffuse nature in which surgical interference might be of benefit. Thus the drainage of a hæmatomyelia or hydromyelia into the subdural space, if it were possible of accomplishment with safety, should at least remove the harmful effects of the pressure of the fluid upon the nerve fibers in the cord. If an internal decompression of the cord were possible, the harmful effects of slow growing and infiltrating tumors should be decreased by an incision into the cord, as should also be the œdema which follows trauma or contusion of the spinal cord after injury to the spine (Allen). A decompressive incision into the cord might also do some good in spinal gliosis.

Isolated cases are to be found in the literature of the subject in which intramedullary tumors were removed with great improvement

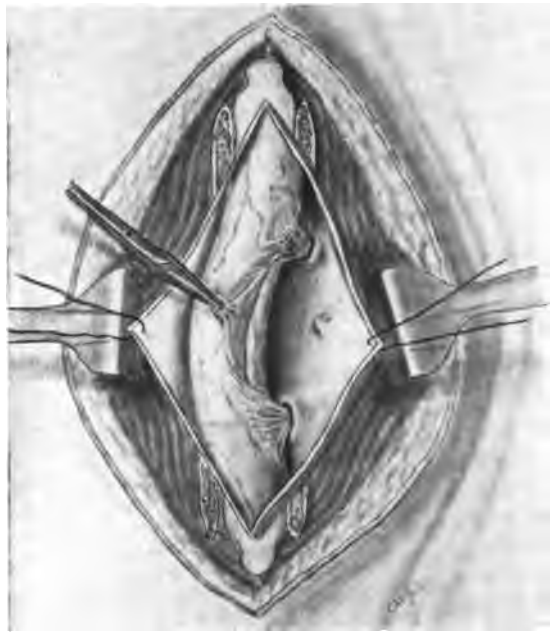


Fig. 3. The method for the exposure of the anterior surface of the cord. The cord is rotated by means of traction on a divided slip of the dentate ligament.

in the patient's symptoms—Röpke (3), von Eiselsberg (4), Schultze (7), Elsberg and

Fig. 4. The appearance of a subpial spinal tumor. Tumors in this location have sometimes been mistaken for true intramedullary neoplasms.

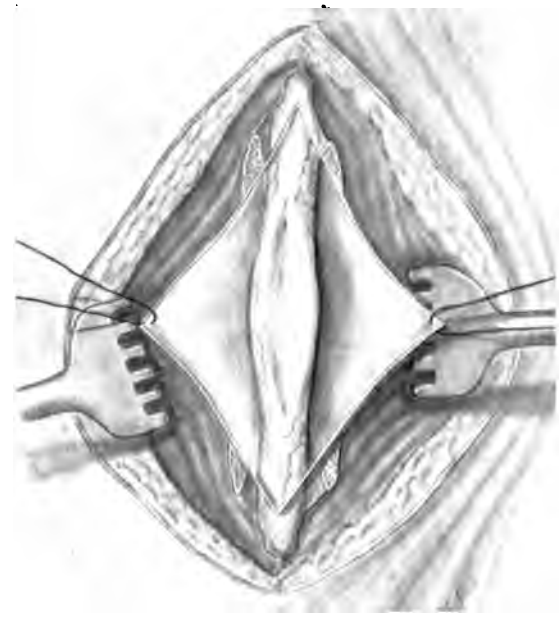


Fig. 5. Appearance of cord after incision of hydromyelia cavity. The openings of the central canal can be plainly seen.

Beer (8); intramedullary cysts and foci of softening have been drained—Krause (2), Elsberg (8); a small, well encapsulated tubercular focus has been removed—Veraguth and Brun (5); the attempt has been made (Abbe, Krause, Elsberg) to drain a syringomyelitic collection of fluid into the subdural space. The cord has been incised in order to remove a bullet from its substance—Braun (6)—and for the purpose of decompression in extensive irremovable tumors (Cushing, Krause, Elsberg).

### THE SURGICAL ANATOMY OF THE SPINAL CORD FROM THE STANDPOINT OF INTRAMEDULLARY SURGERY

Not only from their anatomical position and their physiological character, but also from the ease with which they may be exposed, the posterior columns of the spinal cord are the most favorable for an incision. The fibers in the posterior columns convey principally tactile and deep muscle sensations to higher levels, although the fibers for all varieties of sensation enter the cord in the posterior spinal roots. Our knowledge of the

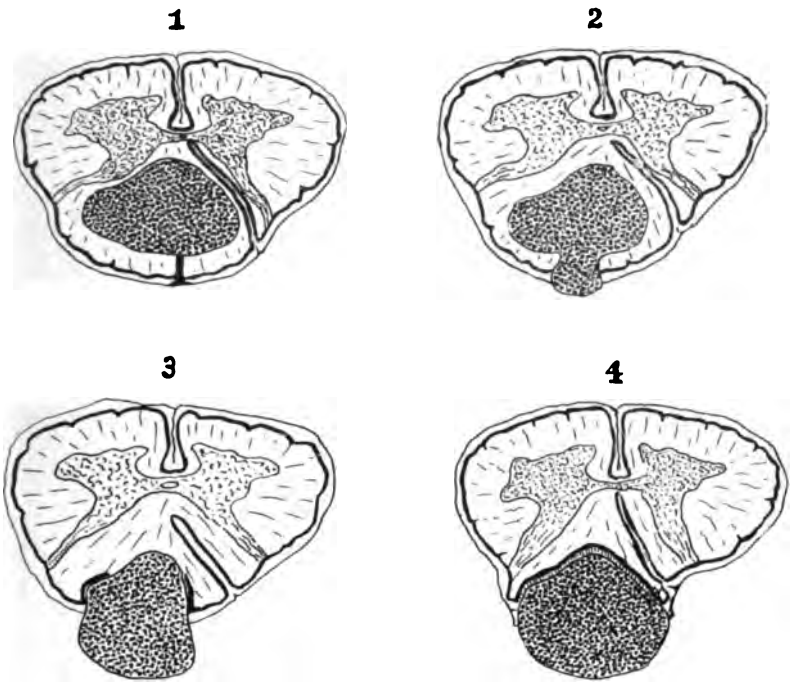



Fig. 6. The extrusion of an intramedullary tumor after the incision into the cord has been made (diagrammatic).

conducting paths for the various sensations is still incomplete; the following is a summary of all that is known:

The fibers for the sensation of pain enter the cord in the posterior roots, and soon pass through the posterior horn and gray matter to the anterior part of the lateral column on the opposite side. The fibers for thermæsthesia take a similar course; they do not cross to the other side so quickly as the pain fibers, but require from two to five segments for the complete crossing. The fibers for touch pass partly along the same course as the pain fibers and partly up the posterior columns on the same side to the posterior column nuclei at the extreme upper end of the cord. In these cloumns also lie the paths for deep muscle sense (postural recognition, spacial discrimination, etc.). When one part of the sensory pathway in the cord is interrupted, other tracts may take up the transmission of sensations. Although this is probably true for all kinds of sensation, the tactile sensations especially seem to run in a bilateral path and are not so apt to be markedly affected by a purely unilateral lesion.[1]

The posterior columns, in short, contain mainly fibers (endogenous and exogenous, primary and secondary paths) which contribute to the transmission of tactile and deep muscle (kinæsthetic) sensations, and we must next determine the course of these tracts in the posterior columns.

As is well known, the fibers from the posterior roots from below upward enter the cord and lie at first just mesial to the posterior gray horn. Some of these fibers remain in the posterior column, where they divide into ascending and descending branches. The ascending branches give off numerous collaterals to the gray horns until the level of the next root above is reached. Fibers from this second root then take their position on the mesial side of the posterior horn, crowding the fibers from the preceding (lower) root more toward the median line. It will be seen,

[1] Rothmann believes that sensory fibers for touch exist also in the anterior columns of the cord.

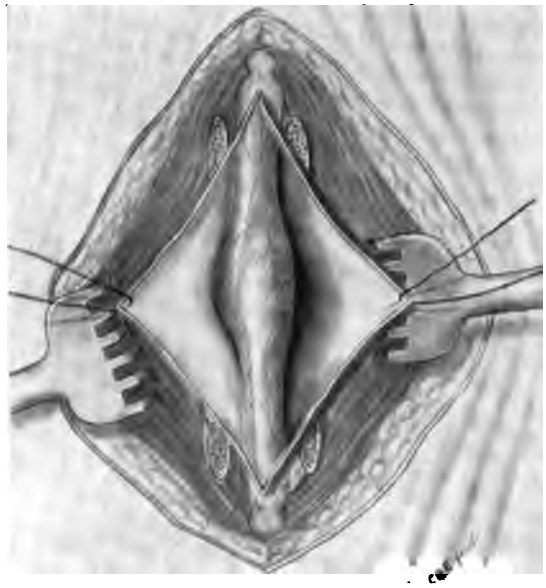


Fig. 7. Case 1. The fusiform enlargement of the cord due to intramedullary tumor.

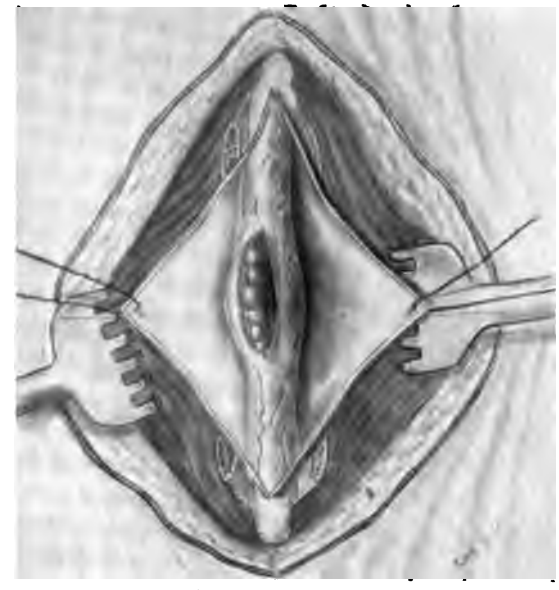


Fig. 9. Case 1. The complete extrusion of the tumor one week after incision of the cord. The tumor lies outside of the cord.

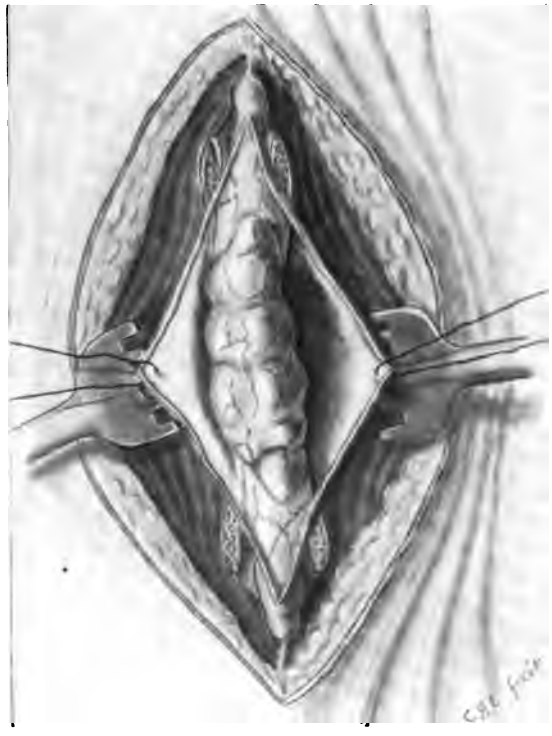


Fig. 8. Partial extrusion of the intramedullary growth in Case 1.

therefore, that the fibers finally form a succession of lamellar tracts which in each case lie at first next to the posterior horn and gradually become shifted medianward by those which enter the cord with the higher nerve roots (Schaefer). This arrangement of tracts in the dorsal columns has been studied in the lower animals by Kahler and many others, while degeneration in the tracts of the cord in man have been described in detail by Schaffer, Ziehen, Collier and Buzzard, Wickmann, Schultze, Petren, and others.

As a result of this arrangement of conducting paths in the posterior columns, the fibers from the sacral posterior roots soon come to lie nearest the posterior median fissure; outside of these run the lumbar root fibers, outside of these, the dorsal, and so on (Fig. 1).

In the lumbosacral region, the columns of Goll and Burdach are not distinct, and the fibers from the posterior roots occupy a great part of the dorsal column; while in the cervical and dorsal regions, the arrangement is such that the posterior median column (Goll) contains only fibers from the sacral, lumbar, and lowest dorsal posterior nerve roots, while the postero-external column of Burdach con-

Fig. 10. Drawing from post-mortem specimen of an intramedullary spinal tumor which has been slightly extruded. The growth extended into the medulla and had grown into the posterior fossa. Extrusion of the spinal growth was impossible on account of the tumor mass above. The growth was at the level of the second cervical segment, and death was due to respiratory paralysis two days after the first operation.

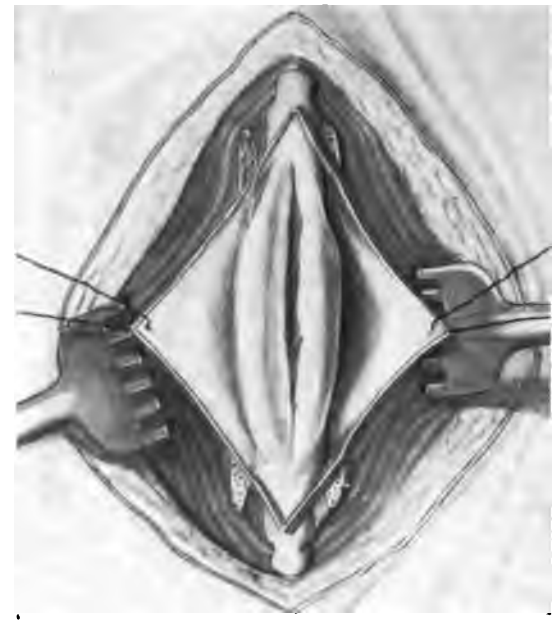


Fig. 11. The appearance of the cord in Case 7 after incision of the swollen cord.

tains the fibers from the upper dorsal and cervical posterior roots (Fig. 1). Therefore, in the lumbosacral region, an incision may be made anywhere in the posterior column. It is best made a few millimeters away from the median line, so that injury may not be done to the descending tracts (triangle of Gombault and Philippe, from the third sacral nerve to the conus) in the sacral region; the oval bundle of Flechsig (from the third and fourth lumbar nerves to the third sacral nerve), and the septomarginal bundle of Bruce and Muir (from the first to the third lumbar nerves) in the lumbar region. The incision should not be too near the posterior root zone, lest it do damage to the marginal fibers. The deeper the incision, the greater the probability of injury to fibers from the higher lumbar roots.

In the dorsal and cervical regions, the incision should always be made in the posterior median column, and the higher the level, the nearer should the incision be to the median line. In the upper and middorsal regions the incision is best made from 2 to 4 mm. from the median line, while from the level of the midcervical region upward it should be

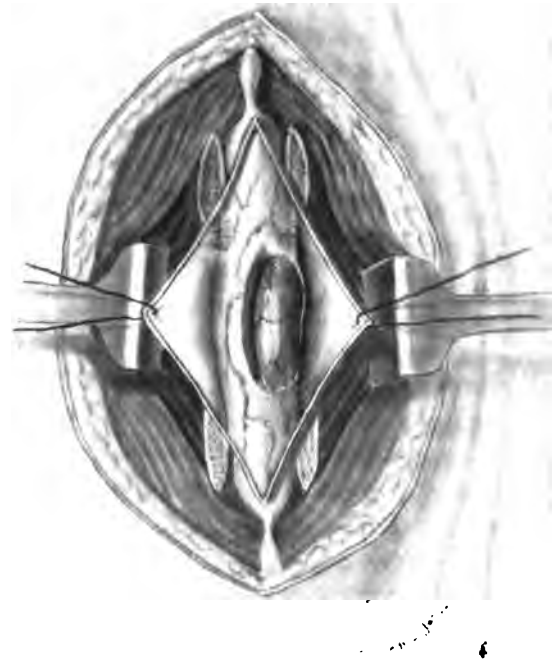


Fig. 12. An extramedullary tumor which lies embedded in the cord. This type of growth has been mistaken for an intramedullary growth.

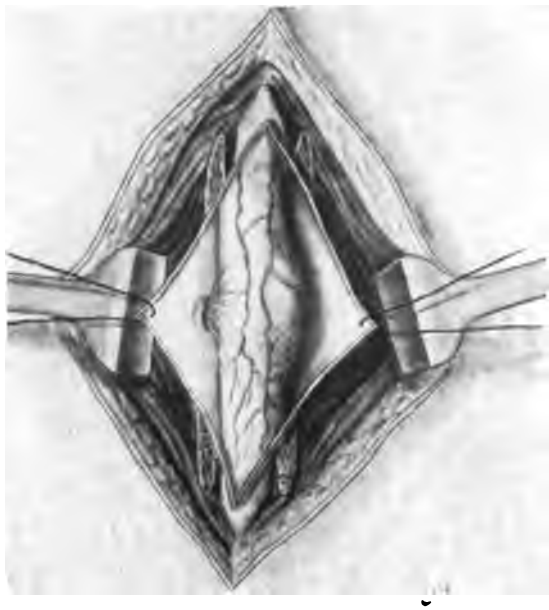


Fig. 13. Case 2. The enlarged cord due to an intramedullary tumor.

Fig. 14. Case 2. The appearance one week after incision of the cord. The tumor, a fibrocyst, has been extruded and lies on the side of the cord.

made very near the median line. The accompanying diagram (Fig. 2) shows the areas in the posterior columns of the human spinal cord in which ascending degeneration occurs after injury to the sacral and lowermost lumbar posterior roots of both sides. Within the areas shaded in black, an incision, made in the posterior column of the one or the other side, will cause a minimum of injury to nerve fibers, and few or no symptoms.

It is important also to remember that in the sacral region there is very little white matter, the bulk of the cord being formed of gray matter. In the thoracic region there is a relatively small amount of gray matter, while in the lumbar and cervical enlargements the gray matter, as well as the white columns, are of large size.

### THE TECHNIQUE OF ASPIRATION AND INCISION OF THE CORD

The cord can be punctured with a needle with entire safety, provided that only the finest aspirating needle is used, and care is taken not to injure even the smallest vessels which enter the cord through the posterior median septum or run in the pia mater. In doing the aspiration, it is advisable to make the puncture near but not through the posterior median septum. The cord must be carefully steadied, as the pia offers some resistance to the entering needle. A slip of the dentate ligament is grasped on each side with fine mosquito forceps and held in place. Extreme care must be taken that the direction of the needle is held constant. Needless to add, the cord must never be grasped with an instrument or with the fingers.

For the incision of the cord, a very fine scalpel, such as the von Graefe knife used by the ophthalmologist, should be used, The arachnoid is first incised and grasped with fine forceps. Then the proper part of the posterior column is selected and an incision less than 0.5 cm. long is made. The incision must be carefully deepened and enlarged, care being taken that it shall be in the long axis of the cord. The enlarging and deepening of the primary incision is best done with a blunt instrument. A small strabismus hook is useful; by its use fewer fibers are divided and more are separated from each other.

The incision should always be slowly made, and should be stopped as soon as there is the slightest bleeding. Sponging should be done with small bits of cotton, with extreme gentleness, so as to make the smallest amount of pressure upon the cord itself. When a cystic collection of fluid or a small area of softening is opened, no effort should be made to remove the fluid in the cavity by sponging or by pressure.[1]

### THE EXPOSURE AND RECOGNITION OF INTRAMEDULLARY LESIONS

A complete laminectomy is always necessary when a thorough exploration and examination of the cord is to be made. This usually means that at least three spinous processes and laminæ have to be removed, and that the laminæ shall be taken away well out to their articulating surfaces. While the operation of hemilaminectomy has its field of usefulness, a wider exposure of the cord is necessary whenever a tumor has to be removed or the cord tissue has to be invaded.

After the dura has been incised, the cord is exposed covered by the pia and the arachnoid, which is usually raised from the cord by fluid. The arachnoid should not be injured when the dural sac is opened and should be incised separately.

It should never be difficult to recognize a tumor that lies underneath the arachnoid membrane and outside of the cord tissue and pia mater, for these growths always lie superficial to the dentate ligament. It is not so easy, however, to differentiate between a subpial growth closely adherent to the cord (see Figs. 4 and 12) and a true intramedullary neoplasm, especially if an intramedullary tumor has broken through the posterior surface of the cord and has then pushed the pia before it. After the surgeon has incised the pia covering the tumor he may think that he is dividing cord tissue when in reality he is incising the capsule of the tumor. At some of my intramedullary operations, I have not been able to convince some colleagues of the true intraspinal location of the lesion because they were not sufficiently acquainted with the appearance of divided cord tissue. In several of my early operations, I was myself in doubt until I had had microscopical examinations made of post-mortem specimens, and of small bits of the tissue which lay superficial to the growth and which was incised before the growth was exposed. In the cases of intramedullary cyst formation, I was able to see the central canal of the cord which opened into the cyst cavity (Fig. 5).

With increasing experience, one is able to clearly recognize when the soft, creamy yellow cord tissue is divided; not only is its color different from that of the pia and of a capsule of a new growth, but also its consistency is very characteristic.

Careful palpation of the cord will often inform the operator that a solid tumor exists in the cord or that the enlargement is due to a collection of fluid. The majority of intramedullary tumors cause a fusiform enlargement of the cord (Fig. 7), so that, as soon as the dural sac is open, it is evident that the lesion is inside of the spinal marrow.

### THE REMOVAL OF INTRAMEDULLARY TUMORS OF THE SPINAL CORD BY THE METHOD OF EXTRUSION

The attempt to remove a growth from within the substance of the spinal cord, no matter how carefully it was done, would require an amount of handling and a degree of manipulation of the delicate tissues of the cord that would, in the large majority of cases at least, be certain to be followed by a traumatic inflammation that would damage or destroy all the elements of the cord at the spot and would probably be permanent in its effects. Therefore, it was necessary to devise a new method for these intramedullary new-growths, and two years ago, together with Dr. Beer, I described a method of operation to which I gave the name "the method of extrusion," by means of which it is possible to remove a tumor from the substance of the cord with a minimum amount of injury to the cord tissue (Figs. 1, 2, 3, 4, and 6).

The theory upon which the method of extru-

[1] The cord may be raised from its bed by means of traction on a posterior root or on a slip of the dentate ligament. If the anterior surface of the cord has to be exposed, this can be satisfactorily accomplished by the division of one of the slips of the dentate ligament, and traction and rotation of the cord by means of the forceps which grasps the divided slip (Fig. 3). The importance of the dentate ligament is very great and its exact structure and relations should be carefully studied by everyone interested in spinal surgery.

sion is based is the following: There must exist within the cord a certain intramedullary pressure, as exists in all solid or fluid substances. When a tumor grows in a part of the cord, the intramedullary pressure must be locally increased. If an incision is made down to the growth, nature will proceed to readjust the pressure conditions, and in so doing, will push out—the conditions being favorable—whatever has caused the local increase of pressure. When, therefore, an incision is made down to the tumor in the cord, the tumor will be slowly pushed out of its bed and will be slowly extruded from the cord substance. Nature will accomplish this process slowly—nerve fibers being slowly pushed to the sides while the growth is being extruded—and with far less injury to the cord structure than by the most careful manipulations of the surgeon.

If these theoretical considerations were correct, then the surgeon would only have to incise the cord down to the tumor and then have to wait for the readjustment of pressure conditions when the tumor should be found outside of the cord tissue.

In the first patient in whom I encountered an intramedullary tumor, I determined to test the correctness of this theory (Case 1). At the operation, the swollen cord was incised, and the incision watched for several minutes. Soon there was to be seen a bulging of a small bit of tumor mass through the incision, and while we watched it, the protrusion gradually increased in size while the incision in the cord gradually lengthened. The muscles, fascia and skin were then closed by suture, and the patient sent back to her bed. One week later, the wound was reopened, and the entire tumor was found lying outside of the cord, so that after the division of a few adhesions the tumor could be removed with practically no touching of the cord itself. The patient made a very good recovery.

This case proved the correctness of the theoretical considerations, and we applied the method to other cases of intramedullary tumors. We have called the method "the method of extrusion."

Based upon the anatomical grounds described in the early part of this paper, and upon the physical process above described, I desire to recommend the method of extrusion for the treatment and removal of intramedullary tumors of the spinal cord. If, after laminectomy and incision of the dura, the surgeon finds that he has to deal with an intramedullary growth, he should make a short incision about 1 cm. long, in the posterior median column a few millimeters outside of the posterior median fissure, at the spot where the growth seems to be nearest the surface of the cord. The incision should be deep enough to divide the pia and the substance of the column down to the tumor. The tumor will then begin to bulge through the incision. No matter how markedly the tumor will protrude, the surgeon must not attempt to remove the growth, for fear of grave injury to the cord. The operation must be concluded for the time being, the dura left wide open, the muscles, fascia and skin carefully closed, and the actual removal of the growth left to a second operation. After about one week, the wound is reopened, and the tumor, which will in all probability be found outside of the cord, can be removed by dividing the few adhesions which remain. When the tumor has been removed, the opening in the pia may be closed by a few very fine (split-silk) sutures, and the dura, muscles, fascia, and skin closed in the usual manner.

If, at the second operation, the tumor is found to be still closely connected with cord tissues, it is advisable to leave it *in situ* and not attempt its removal. In one instance, an intramedullary fibrolipoma, I made the error of attempting to remove a small part of the tumor which was still closely connected with the cord, and caused the symptoms of a transverse lesion, which had existed before the extrusion of the tumor, to reappear. In several later cases, having learned my lesson, I allowed the tumors to remain and left the dura wide open. These patients have improved so much that a later operation seemed unjustifiable. Cushing has had a similar experience.

In the case of intramedullary tumors which extend over a large number of segments, and which infiltrate the cord substance, a small incision into the cord made in the manner above described at the level of the

most marked symptoms may allow of the partial extrusion of the tumor, with amelioration of the symptoms.

Up to the present time I have applied the principles of intramedullary surgery above laid down to eleven cases of intramedullary diseases—eight cases of intramedullary tumor, two cases of hydromyelia and intramedullary cyst formation and one case of syringomyelia with marked glia formation. In all of the patients who could be followed for long periods of time, there was a very decided and in some of them a very marked improvement. As most of the cases have been reported elsewhere, I shall give only the synopses of the histories in this place.

CASE 1. Intramedullary glioma of the cervical cord; laminectomy, incision of cord, extrusion of tumor, removal; recovery. Result, very marked improvement with return of power in all extremities. Patient returned to her work (Figs. 7, 8, and 9).

CASE 2. Intramedullary glioma of cervical cord; laminectomy, incision of cord, extrusion of tumor, removal, death in four hours from respiratory paralysis.

CASE 3. Intramedullary sarcoma of cervical cord; laminectomy (Dr. Beer); extrusion, removal, recovery. Result, marked improvement; later, recurrence, operation, removal of recurrent tumor mass; no improvement.

CASE 4. Infiltrating tumor (glioma) of upper cervical cord and medulla oblongata; laminectomy and incision of cord; partial extrusion of tumor; death after two days from respiratory paralysis. Post-mortem showed that the tumor extended into the medulla and had grown through the posterior surface into the posterior cranial fossa (Fig. 10).

CASE 5. Hydromyelia, laminectomy, incision of cord, drainage of cord cavity into subdural space. Result, great improvement of complete paralysis of lower and partial paralysis of upper extremities, so that patient is up and about and has returned to his work (Fig. 5).

CASE 6. Intramedullary tumor of cervical cord; laminectomy, incision of cord, partial extrusion of diffuse tumor of cord; some improvement.

CASE 7. Syringomyelia; gliosis cervicalis; laminectomy, incision of cord in cervicodorsal region for decompressive purposes; marked improvement in power of upper extremities (Fig. 11).

CASE 8. Diffuse meningomyelitis with intramedullary cyst; laminectomy, incision of cord, drainage of intramedullary cyst; no improvement. Death three months later from exhaustion; post-mortem showed extensive lesions throughout dorsal and lumbar cord.

CASE 9. Intramedullary lipoma of cervical cord; laminectomy, incision of cord, partial extrusion of tumor. Great improvement so that quadriplegic patient has recovered almost complete power in the upper and much power in the lower extremities.

CASE 10. Intramedullary fibrolipoma of cervical cord; laminectomy, incision of cord, extrusion of tumor, great improvement in symptoms with disappearance of paralysis of upper and improvement in paralysis of lower extremities. Later, removal of tumor, which is not entirely extruded from the cord, followed by symptoms of transverse myelitis. Thereafter slow improvement.

CASE 11. Intramedullary fibrocyst of cervical cord; laminectomy, incision of cord, extrusion of cyst, removal at second operation, almost complete recovery, continuous improvement (Figs. 13 and 14).

## REFERENCES


1. ABBE.
2. KRAUSE. Chir. des Gehirns und Rückenmarks, xii.
3. RÖPKE. Arch. f. klin. Chir., 1911, cxvi, 963.
4. VON EISELSBERG. (See Röpke.)
5. VERAGUTH and BRUN. Cor. Bl. f. schweiz. Ärzte, 1910, No. 33.
6. BRAUN. Verhandl. d. deutsch. Gesellsch. f. Chir., 1906.
7. SCHULTZE. Deutsche med. Wchnschr., 1912, No. 36, Sept. 5.
8. ELSBERG and BEER. Am. J. M. Sc., 1911, Nov.; also ELSBERG, J. Am. M. Ass., 1912, October 26th.
9. STARR. Text-book of Nervous Diseases, 1909, p. 442.
10. GOWERS. Diseases of the Nervous System, 1899, p. 609.
11. FLATAU. Handbuch der Neurologie, ii, p. 640.

# THE HEART IN FIBROID TUMORS OF THE UTERUS

By JOHN A. McGLINN, A. B., M. D., Philadelphia

THE frequent association of cardiac lesions with fibromyomata of the uterus, noted both clinically and at autopsy, has led to the belief that a causal relation exists between them. Many authorities have gone so far as to assume that there is a specific form of heart disease associated with these tumors, which has been designated as the fibroid heart. A review of the literature shows it to be particularly rich in the subject under discussion and with few exceptions the authors maintain the view of causal relationship. While all do not speak of a fibroid heart as an entity, still there is a more or less unanimity of opinion that such an entity exists. The universality of this opinion is expressed by Barrows (1) in a very recent article, who says, "In all the literature at my command I can find but two dissenting opinions, that of Neu (2) and McGlinn (3)." Other exceptions, however, appear in the literature; notably, McDonald (4), Jaschke (5), Neu and Wolf (6), Kelly and Noble (7), Kelly and Cullen (8), Brickner (9), Rosthorn (10), and Winter (11).

The belief of causal relationship and of a fibroid heart is based principally on (*a*) The frequent association of organic and functional heart lesions with uterine myomata; (*b*) deaths both before and after operation, explainable only by heart failure; (*c*) the study of a comparatively few post-mortem records of such deaths; (*d*) conclusions based on various theories advanced to explain the causal relationship and the mode of production of the fibroid heart. The literature in support of this view is too voluminous to quote in detail, but for the convenience of the readers a partial bibliography is appended. The more important articles in this class are those by Shoemaker (12), Baldy (13), Williams (14), Doane (15), Barrows, Fleck (16), Doran (17), Cumston (18), Sebileau (19) and Boldt (20).

The heart lesions most frequently described as being found are brown atrophy, fatty degeneration of the myocardium, cloudy swelling, myocarditis, hypertrophy, dilatation, arrhythmia and valvular disease. It is not the purpose of this paper to prove that there is no connection between uterine fibroids and heart disease, but it is intended as an effort to clarify the subject and place the connection upon a rational basis. That changes take place in the heart as a direct result of uterine myomata is not to be denied. My belief in the matter is that there is no proof of the existence of a distinct fibroid heart and that all the changes which are commonly found can be explained by what might be termed accidents of the presence of the tumor. Further, while we believe that hæmorrhages, infections, degenerations, and resistance to circulation by pressure on pelvic vessels and by large tumors do produce cardiac changes, the general assumption that all the cases of degenerations, hypertrophy, dilatation, myocarditis and sclerotic changes found in connection with uterine myomata are due to the tumor not only lacks confirmation, but the weight of the evidence is against the acceptance of this view.

The present study is based on the records of 2700 autopsies made at the Philadelphia General Hospital and is supplemented by a study of 3000 autopsy records from the same source, previously reported in the New York Medical Journal of June 3, 1911. Of the 2700 records, 632 were those of female bodies, in 131 of which fibroid tumors of the uterus were found. In the paper previously reported, 113 tumors were studied, making a total of 244 cases upon which to base this report.

Table I represents the report of 131 tumors studied from the standpoints of age, race, clinical diagnosis, position of the tumor, size of the tumor, associated heart lesions and associated pathological lesions of other organs.

Table II shows the heart lesions found in connection with 100 cases of uterine myomata compared with the heart lesions found in 100 other cases of the same age and race in which such tumors were not present.

The subsequent tables show these 100 cases

of fibroid tumors of the uterus, divided into ten-year age periods, compared with equal numbers of non-fibroid cases of the same ages and race.

The method of collecting the cases without fibroids for comparison was as follows: When a case with a uterine fibroid was found in the records, the age and race were noted. The records were then searched consecutively until a report was found of a woman of the same age and race without a fibroid. No attempt was made to select cases, so that I believe these tables offer an impartial basis for comparison as to the frequency and character of heart lesions in women with and without fibroid tumors of the uterus.

In the final table, 13 additional cases between the ages of 20 and 40 are added to the 15 in the original series found between these ages. The purpose of this was to eliminate the age factor as far as possible in the causation of certain lesions. It was felt that 15 cases hardly presented a fair basis for comparison.

In the 632 female bodies uterine fibroids were found 131 times, or in 20.57 per cent, a rather remarkable showing of the frequency of these tumors. Of the 131 women, 74 were white, 56 negroes, and 1 Indian.

The average age of the women was 40.5 years, divided in age periods as follows:

| | | |
|---|---|---|
| 20 to 29 years, | 5 cases, | 3.84 per cent |
| 30 to 39 years, | 17 cases, | 13.08 per cent |
| 40 to 49 years, | 32 cases, | 24.61 per cent |
| 50 to 59 years, | 30 cases, | 23.07 per cent |
| 60 to 69 years, | 32 cases, | 23.84 per cent |
| 70 to 79 years, | 9 cases, | 6.94 per cent |
| 80 years and over, | 6 cases, | 4.62 per cent |

It is rather startling to note that out of the 131 cases but three (1100, 1938, 2527) were diagnosed clinically as fibroids of the uterus. A résumé of the cases, however, will show that with but few exceptions the tumors were so small or so situated that it would have been difficult to make a diagnosis even if a pelvic examination had been made. The relatively small size of the tumors, I think, gives added interest to this study, because if there are changes in the heart depending upon the presence of the tumors it shows that the size and situation of the neoplasms play little or no part in the production of the changes.

The heart lesions found in the cases in Table I are as follows:—

| | |
|---|---|
| Normal hearts | 7 |
| Hypertrophy of left ventricle | 4 |
| Hypertrophy and dilatation of both ventricles | 1 |
| Dilatation of left ventricle | 3 |
| General hypertrophy | 35 |
| Hypertrophy and dilatation of left ventricle | 2 |
| General dilatation | 25 |
| Dilatation of left auricle | 1 |
| Dilatation of right auricle | 2 |
| Myocarditis | 27 |
| Brown induration | 1 |
| Soft myocardium | 3 |
| Cloudy swelling | 10 |
| Aortic sclerosis | 37 |
| Pulmonic sclerosis | 1 |
| Atheroma of aorta | 19 |
| General sclerotic changes | 2 |
| Chronic endocarditis | 11 |
| Acute pericarditis | 1 |
| Hydropericardium | 3 |
| Patulous foramen ovale | 1 |
| Syphilis of heart | 1 |
| Dilatation of right heart | 1 |
| Fatty degeneration | 27 |
| Brown atrophy | 5 |
| Pale myocardium | 3 |
| Mitral sclerosis | 45 |
| Tricuspid sclerosis | 4 |
| Chronic valvulitis | 12 |
| Coronaries sclerotic | 11 |
| Acute endocarditis | 2 |
| Subendocardial hæmorrhage | 1 |
| Chronic pericarditis | 6 |
| Tubercular pericarditis | 1 |
| Atrophy of heart | 1 |
| Sarcoma of heart | 1 |
| Total variety of lesions | 35 |
| Total number of lesions | 300 |
| | 310 |

In considering the possible relation of the fibroid tumors to these lesions it may be well to discuss at the same time the various theories which have been advanced to explain the relationship. Among which are:—

*First.* Hæmorrhages become the cause of great weakness, and the heart, being poorly nourished, degenerates.

*Second.* Anæmia resulting from hæmorrhages is responsible for the degenerations and dilatations.

*Third.* More or less constant loss of blood will produce fatty degeneration and brown atrophy.

*Fourth.* Changes in the heart muscle may result from alterations in the blood pressure incident to hæmorrhages.

*Fifth.* A toxin produced during the growth of the tumor causes degenerative changes in the heart and blood-vessels.

*Sixth.* Fibroid tumors of the uterus are only a local feature of a general process.

*Seventh.* Poisonous products are produced by the grossly changed ovaries present in fibroid tumors, and these, acting on the heart, cause the various degenerations.

*Eighth.* Heart lesions are secondary to changes produced in the kidneys by pressure on the ureters.

*Ninth.* Hypertrophy results because the heart has added work to perform to supply the tumor with blood.

*Tenth.* Pressure on the vessels in the pelvis increases circulatory resistance and leads to hypertrophy of the heart.

*Eleventh.* Infections of the tumor may lead to secondary degenerative heart changes.

*Twelfth.* Infections of the bladder may ascend and affect the kidneys and in turn give rise to degenerative heart changes.

*Thirteenth.* Pain influences the regularity of the heart's action. Pain in fibroids produces arrhythmia.

*Fourteenth.* Pressure of the tumor on the sympathetics may produce arrhythmia.

*Fifteenth.* "A reflex from the uterus may influence by centripetal action a certain point of the nervous centers which is transmitted centrifugally to the arterioles; from this results a contraction of these arterioles, an exaggeration of pressure in the small circulation, and an excess of work to the heart to which it succumbs" (Potain).

In considering the possibility of the existence of a fibroid heart, all these theories can be dismissed with the exception of the fifth and sixth. Manifestly none of the others are applicable to all cases of fibroid tumors.

Considering, then, the only two rational theories, namely, that the tumor, in its growth develops a toxin which affects the heart, and that the fibroid tumor is only a local manifestation of a general process, it is reasonable to assume that if either of these theories were true, the heart would show some distinct change which would be common to all cases. This study proves that this is not so. We find in Table I that there are 35 distinct lesions, no one of which (mitral sclerosis) occurs in more than 45 of the cases. The same thing is true in the second series of 100 cases (Table II) in which there are 30 distinct lesions no one of which (mitral sclerosis) occurs in more than 57 of the cases.

Again, if the heart changes were dependent upon a toxin elaborated by the tumor, we should expect to find the extent of the changes depending upon the size of the tumor, as it is reasonable to assume that a large tumor would generate more toxic matter than a small one. *Per contra*, if a fibroid tumor of the uterus is simply a local manifestation of a general process, we should find the largest tumors in those cases which show the greatest changes in the cardiovascular system. A study of Table I does not bear out these contentions. Thus in case No. 525, with one subserous tumor measuring 1.5 cm. in diameter, the heart weighed 550 gms. and showed hypertrophy and fatty degeneration, while in No. 1100, with a tumor weighing 1630 gms., the heart weighed but 320 gms. and the only change recorded was myocarditis. Similar comparisons can be made between Nos. 260 and 511; 937 and 989; 1707 and 1951; 2160 and 2186, etc.

It may be argued that in both these series there is a more or less constant change in the cardiovascular system; namely, that of sclerosis. To a certain extent this is true; thus, in Tables I and II, totaling 231 cases, we find 541 lesions of which 326, or 60.3 per cent, are sclerotic in character. If we study the first series we find that of the 131 cases, 108, or 82.44 per cent, occurred after the age of 40 years, a period in which sclerotic changes of the cardiovascular system are the rule and not the exception. This relationship of age to sclerotic changes in the heart and vascular system is best shown in the second series under Tables III, IV, V, VI, VII, VIII, IX, X. These tables are arranged in various age groups of ten years to show the heart changes in fibroid tumors at various ages compared with the heart changes in an equal number of non-fibroid cases of the same age and race.

In the second series of 100 cases of fibroids 195 sclerotic lesions were found and exactly the same number were present in the non-fibroid cases. In all the age periods beyond 40 years, with the exception of the period between 70 and 79, not only were the sclerotic

changes more common in the non-fibroid cases, but all cardiac lesions were in excess of the fibroid ones.

In Table X, which represents 28 cases of fibroids compared with the same number of non-fibroids between the ages of 20 and 40 years, we find that the heart lesions in the fibroid cases are far in excess of those in the non-fibroid ones. From this it may be argued that eliminating the age factor, fibroids do produce sclerotic changes. This inference I do not believe to be justified. The number of cases for comparison is entirely too small upon which to base a just conclusion. Again, if it is argued that fibroids do produce sclerotic changes of the heart, they must be considered selected cases and if compared with another series of selected cases, such as interstitial nephritis, the heart lesions in the latter will far outnumber those found in the former. The number of non-fibroid cases in this table could not have been better selected to show the absence of sclerotic changes, as in only 6 of them (uræmia, 4; syphilis, 2) were any lesions present which could produce such changes.

In the two series there were 50 cases of fibroids between the ages of 20 and 40. Sclerotic changes were noted in 22 of these cases and absent in 28. In Table I, the largest tumors were in those cases which showed no sclerotic changes. The smallest tumors were associated with the most marked sclerotic changes. Again, in Table I, the sclerotic lesions numbered 17, divided among 11 cases. In these same cases were such lesions as syphilis, arteriosclerosis, cirrhosis of the liver, and acute and chronic nephritis which might be held responsible for the sclerotic changes in the heart. Therefore, in view of the fact that sclerotic changes in the heart were not a constant finding, that the largest tumors were not associated with such changes, and that other lesions were present to account for the scleroses, I believe that we are justified in assuming that no relationship between them can be proven.

No other one lesion occurs frequently enough to be considered as a typical heart change depending upon the presence of the uterine tumor. Let us consider briefly, however, those lesions which are most frequently ascribed to the fibroid; hypertrophy, dilatation, fatty degeneration, brown atrophy, cloudy swelling, and myocarditis.

Hypertrophy was found as follows in the first series of cases: General, 35; hypertrophy of left ventricle, 4; hypertrophy with dilatation of the left ventricle, 2; hypertrophy with dilatation of both ventricles, 1; a total of 42 times. Theories eight and nine can only be considered in the discussion of the cause of hypertrophy; theory fifteen is entirely too fanciful to receive serious consideration. In only six of the cases in Table I (512, 551, 1003, 1938, 1991, 2186) was the tumor of such a size as to increase the work of the heart, or so situated as to cause pressure and increase circulatory resistance. In none of the other cases was the tumor larger than 4 cm. and in the majority of cases it was 2 cm. or less. It is evident, then, that the hypertrophy in the other 36 cases must have been independent of the fibroid. A little study of Table I will show that in these cases the tumor has nothing to do with the production of cardiac hypertrophy and that it was caused by conditions entirely foreign to the myomata. Thus in case No. 509 we find the hypertrophy due to disease of the mitral valve and arteriosclerosis of the kidneys. Again in case No. 512, the lesion was secondary to mitral and aortic valvular disease and sclerotic kidneys. Practically the same causes can be shown in Nos. 551, 891, 1051, 1134, 1313, 1680, etc. In other cases different lesions can be shown to have been the cause. Thus in cases Nos. 709, 937 and 1011 atrophic cirrhosis of the liver was the underlying cause of the hypertrophy. In cases Nos. 1026, 1051, 1134, 1324, 1476, etc., the primary cause was arteriosclerosis. Other cases can be cited in Table I, where still other conditions, entirely foreign to the myomata, were the cause of the cardiac hypertrophy. Table II, shows that hypertrophy was practically as frequently met with in the non-fibroid as in the fibroid cases—29 in the former and 34 in the latter.

While we can accept the theory that fibroid tumors of the uterus do cause cardiac hypertrophy I believe that we must conclude that all cases of hypertrophy found in connection

with such tumors are not produced by them and that the only manner in which they can produce such a heart lesion is in the manner set forth in theories numbers eight and nine.

In Table I cardiac dilatation affecting the whole or a part of the heart was present in 32 of the cases. In Table II dilatation was noted in 9 of the fibroid cases and in 21 of the non-fibroid. Such an unstable lesion can hardly be considered as a specific form of cardiac disease, especially as it occurred more frequently in cases without tumors than in those with tumors. That it may be secondary to hypertrophy and fatty degeneration, which in some cases are dependent upon the tumor, is admitted, but that its presence can always be accounted for by the fibroid is denied. The usual cause of cardiac dilatation is valvular disease. In Table I dilated hearts are noted in cases Nos. 709, 1388, 1476, 1760, 1951, 2549, 2660, and 2856, which are independent of sclerotic valvular disease, and are apparently dependent upon fatty degeneration of the myocardium. In 5 of these cases (1388, 1476, 1760, 2660, 2856), however, the tumor was so small and so situated that it could hardly be responsible for the fatty degeneration. Thus in the entire series of cases we have but three examples of the lesion where the tumor was the likely cause.

Fatty degeneration of the heart was present in 27 of the 131 cases in the first series. This lesion is commonly found in connection with hypertrophy and dilatation, in anæmic and cachectic states, and after the age of 40. The mode of production of fatty degeneration of the heart by fibroid tumors of the uterus can only be explained by anæmia from loss of blood, infections of the tumor or surrounding structures, malignant degenerations, a specific toxin, and secondary to hypertrophy and dilatation. As we have already proven that hypertrophy and dilatation are seldom the direct result of the tumors, and that there is no reason to believe in the presence of a specific poison, and as no cases of malignant degeneration or infection are reported in this series, it remains but to show how many of the cases were dependent upon anæmia resulting from hæmorrhages. In ten of the 27 cases of fatty degeneration the tumor was so situated and of such a size as would likely produce hæmorrhage (Nos. 221, 571, 709, 713, 1488, 1528, 1850, 2220, 2773). In one of these cases (No. 1850) the anæmia was due to ulcerative enterocolitis, the case being recorded as one of pernicious anæmia due to the intestinal condition. In the other 9 cases the ages vary from 46 to 83 years, so that in some the hæmorrhages must have ceased and the body recovered from the anæmia. Ignoring these factors for the sake of argument, we have but 10 out of 131 cases in which the tumor could have been responsible in any way for the fatty degeneration. In Table II we find that this lesion was more common in the non-fibroid than in the fibroid cases.

A fair conclusion in reference to this lesion would be that while under certain circumstances fatty degeneration of the heart may be caused by fibroid tumors of the uterus, all cases of this lesion found in connection with such tumors cannot be ascribed to them.

Brown degeneration of the heart was noted in 6 cases in Table I, and in 7 in Table II; a total of 13 in 231 cases. The usual cause of this condition is old age and advanced valvular disease. In Table I, brown atrophy is found in cases Nos. 238, 811, 1254, 2349, 2557, and 2768. The ages of these cases are 65, 78, 57, 67, 84 and 53. In all except No. 238 advanced age or sclerotic valvular changes are present to account for the presence of the lesion. In case 238 the age (65) may be considered advanced enough in itself to account for the lesion but the fact that the woman also had advanced cancer and that the fibroid was very small would eliminate the tumor as the cause of the condition in this case. Thus in this entire series we do not find a single case of brown atrophy which was likely produced by the fibroid tumor. In fact, the lesion appears so seldom in connection with fibroid tumors that it can hardly be considered anything but a casual lesion.

Cloudy swelling of the myocardium is noted in ten of the cases in Table I, and in two in Table II, a total of 12 in the entire series. The usual cause of cloudy swelling is an intoxication. In all the cases in Table I (464, 1525, 1615, 1718, 1800, 2125, 2220, 2339, 2766, 2858) some disease capable of and usual-

ly producing severe systemic intoxication was present, peritonitis, pneumonia, tuberculosis, and nephritis. With these diseases present to produce the condition and it being so infrequent, I hardly believe that it can ever be ascribed to fibroids except in event of infections or malignant degenerations.

Chronic myocarditis occurs in 27 of the cases in Table I, and in 15 in Table II, a total of 42 times in 231 cases. In Table II it is shown that chronic myocarditis is no more common in fibroid than non-fibroid cases. Chronic or fibroid myocarditis is frequently associated with sclerotic changes in the coronary arteries and valves; it is common late in life and is secondary to various intoxications. While we may assume that myocarditis may result from infections and degenerations of a fibroid tumor, in order to prove that it did result entirely from the tumor in a given case we would have to eliminate the usual causes of its production. In Table I there is no record of infection of the tumor and no degeneration except calcification. In all the cases of myocarditis recorded there are lesions present in the heart or other organs which could produce the condition. We are safe in saying that in this series there is not a single case of myocarditis which could be attributable to the tumor. When we find that myocarditis is just as common in cases without fibroids as in those with them, and when infections and degenerations of the tumors which might produce it are so rare, it must be concluded that this lesion, depending entirely upon the presence of a myomata, must be extremely uncommon.

It is impossible from a study of this character to present much data in relation to the association of arrhythmia and with fibroids. That arrhythmia does occur is of course acknowledged, but is it not fair to assume that in the majority of cases it is a symptom of the myocarditis which is so frequently present and which bears no relation to the presence of the tumor?

Other heart lesions, not usually described, may result from a fibroid tumor, such as infections of the endocardium and pericardium from infections of the tumor, and metastases in the case of malignant degeneration, but these would be extremely rare and would be purely accidental.

The number of cases studied in this report is, I believe, sufficient upon which to base the following conclusions:

*First.* From this report a definite entity of a fibroid heart cannot be sustained.

*Second.* If the fibroid tumors of the uterus were the cause of all the heart lesions described in this study, then every tumor, regardless of its size and situation, should be removed—a contention that the most radical would hardly admit.

*Third.* Uterine myomata, occurring in middle and advanced life, are practically always associated with sclerotic heart lesions. These lesions are a part of a general process and bear no relation to the fibroid.

*Fourth.* Large tumors, by increasing the work of the heart, and tumors causing pressure on the pelvic circulation may produce hypertrophy and secondary dilatation of the heart.

*Fifth.* Anæmia, from hæmorrhages, infections and certain degenerations of the tumor, may affect the heart secondarily, causing changes such as fatty degeneration, brown atrophy, and cloudy swelling.

*Sixth.* The majority of cases of fatty degeneration, brown atrophy, cloudy swelling, myocarditis, etc., found in connection with fibroid tumors of the uterus are not caused by the tumor, but by conditions entirely foreign to the tumor.

TABLE I

Autopsy No. 221. White, age 53. Clinical diagnosis: Hemiplegia, uræmia. Position of tumor: One submucous polyp. Size of tumor: 1 cm. Heart condition: Weight (?), fatty. Associated pathological findings: General arteriosclerosis; chronic interstitial nephritis.

Autopsy No. 238. White, age 65. Clinical diagnosis: Cholecystitis. Position of tumor: One interstitial. Size of tumor: 2 cm. Heart condition: Weight, 145 gms. Brown induration of myocardium. Associated pathological findings: Cancer of kidney; metastases to liver, lung and pleura.

Autopsy No. 244. White, age 59. Clinical diagnosis: Cancer of stomach. Position of tumor: Few interstitial; one submucous. Size of tumor: Small. Heart condition: Weight, 320 gms. Interstitial myocarditis; mitral sclerosis. Associated

pathological findings: Cancer of sigmoid; metastases to liver; fatty liver; gall-stones; chronic parenchymatous nephritis.

Autopsy No. 260. White, age 66. Clinical diagnosis: Abdominal aneurism; arteriosclerosis. Position of tumor: One subperitoneal. Size of tumor: Small. Heart condition: Weight, 480 gms. Acute vegetative endocarditis; chronic endocarditis. Associated pathological findings: Arteriosclerosis.

Autopsy No. 262. White, age 42. Clinical diagnosis: Cirrhosis of liver. Position of tumor: One subserous. Size of tumor: 1¾ cm. Heart condition: Weight, 310 gms. Pericarditis; mitral sclerosis. Associated pathological findings: Gall-stones; cirrhosis of liver; chronic interstitial nephritis.

Autopsy No. 264. Black, age 30. Clinical diagnosis: Pulmonary tuberculosis. Position of tumor: One subserous. Size of tumor: 5 cm. Heart condition: Weight, 300 gms. Hydropericardium; sclerotic mitral and tricuspid valves; myocarditis. Associated pathological findings: Miliary tuberculosis; subacute nephritis; acute gastritis; tubercular enteritis.

Autopsy No. 345. White, age 78. Clinical diagnosis: Mitral regurgitation. Position of tumor: One subserous. Size of tumor: 3 cm. Heart condition: Weight, 380 gms. Myocarditis; chronic mitral endocarditis; atheroma of aorta; patulous foramen ovale. Associated pathological findings: Chronic diffuse nephritis.

Autopsy No. 464. Black, age 42. Clinical diagnosis: Tubercular peritonitis. Position of tumor: Multiple. Size of tumor: (?) Heart condition: Weight, (?); Cloudy swelling. Associated pathological findings: chronic purulent peritonitis.

Autopsy No. 478. White, age 46. Clinical diagnosis: Hemiplegia; myocarditis. Position of tumor: One subserous. Size of tumor: Small. Heart condition: Weight, 290 gms. Sclerotic mitral and aortic valves; atheroma of aorta. Associated pathological findings: Œdema of meninges.

Autopsy No. 509. Black, age 42. Clinical diagnosis: Nephritis; Œdema of lungs. Position of tumor: Many interstitial and subserous. Size of tumor: Small. Heart condition: Weight, 400 gms. Hydropericardium; hypertrophy and dilatation of left ventricle; sclerosis of mitral valve and coronary arteries. Associated pathological findings: Gall-stones; arteriosclerotic kidneys; tubercular mesenteric lymph nodes.

Autopsy No. 511. Black, age 45. Clinical diagnosis: Chronic nephritis. Position of tumor: One subserous. Size of tumor: Large. Heart condition: Weight, 300 gms. Normal heart. Associated pathological findings: Acute parenchymatous nephritis.

Autopsy No. 512. Black, age 56. Clinical diagnosis: Uræmia; endocarditis. Position of tumor: One interstitial. Size of tumor: Large. Heart condition: Weight, (?). Hypertrophy and dilatation of ventricles; sclerosis of mitral and aortic valves; atheroma of aorta. Associated pathological findings: Hæmorrhagic pancreatitis; arteriosclerotic kidneys.

Autopsy No. 520. Black, age 75. Clinical diagnosis: Pericarditis; pneumonia. Position of tumor: Two subserous. Size of tumor: Walnut. Heart condition: Weight, 350 gms. Hypertrophy; pericarditis; atheroma of aorta. Associated pathological findings: Echinococcus cyst of liver; arteriosclerosis of kidneys.

Autopsy No. 525. White, age 48. Clinical diagnosis: Myocarditis; nephritis; anasarca. Position of tumor: One subserous. Size of tumor: 1½ cm. Heart condition: Weight, 550 gms. Hypertrophy; fatty degeneration. Associated pathological findings: Gall-stones; fatty liver; obesity; chronic nephritis.

Autopsy No. 537. White, age 44. Clinical diagnosis; Transverse myelitis. Position of tumor: One subserous. Size of tumor: Small. Heart condition: Weight, 250 gms. Slight sclerosis of aortic valve. Associated pathological findings: Fracture of spine; arteriosclerosis.

Autopsy No. 551. White, age 66. Clinical diagnosis: Myocarditis; chronic interstitial nephritis. Position of tumor: multiple. Size of tumor: Largest, 10 cm. Heart condition: Weight, 850 gms. Hypertrophy; sclerosis of mitral and aortic valves; atheroma of aorta. Associated pathological findings: Nutmeg liver; chronic nephritis; hydrothorax.

Autopsy No. 571. White, age 49. Clinical diagnosis: Myocarditis; pneumonia; anæmia; chronic nephritis. Position of tumor: One submucous polyp. Size of tumor: 4 cm. Heart condition: Weight, 360 gms. Fatty infiltration. Associated pathological findings: Arteriosclerosis; chronic interstitial nephritis; fatty liver; gastritis; acute enteritis.

Autopsy No. 589. Black, age 34. Clinical diagnosis: Cerebrospinal syphilis; phthisis; nephritis. Position of tumor: One subserous. Size of tumor: Large. Heart condition: Weight, 230 gms. Soft and flabby myocardium. Associated pathological findings: Cancer of lung, liver, and pancreas; chronic diffuse nephritis.

Autopsy No. 616. White, age 64. Clinical diagnosis: Pneumonia; myocarditis; nephritis. Position of tumor: One interstitial. Size of tumor: 1½ cm. Heart condition: Weight, 320 gms. Chronic myocarditis; fatty degeneration. Associated pathological findings: Chronic interstitial nephritis with acute exacerbation; fatty liver.

Autopsy No. 666. Black, age 34. Clinical diagnosis: Myocarditis; nephritis. Position of tumor: One subserous polyp. Size of tumor: ½ in. Heart condition: Weight, 200 gms. Myocarditis; valvular endocarditis; atheroma of aorta. Associated pathological findings: Atrophic cirrhosis of liver; chronic interstitial nephritis; enteritis.

Autopsy No. 685. Black, age 53. Clinical diagnosis: Myocarditis; chronic nephritis. Posi-

tion of tumor: Two submucous polyps. Size of tumor: 1 cm. Heart condition: Weight, 530 gms. Dilatation; sclerotic changes. Associated pathological findings: Arteriosclerosis; diffuse nephritis; papilloma of ovary.

Autopsy No. 688. Black, age 38. Clinical diagnosis: Myocarditis; nephritis. Position of tumor: One submucous. Size of tumor: 4 cm. Heart condition: Weight, 520 gms. Fibroid myocarditis; hypertrophy of left ventricle. Associated pathological findings: Pleurisy with effusion; chronic diffuse nephritis.

Autopsy No. 709. White, age 83. Clinical diagnosis: Jacksonian epilepsy; endocarditis; nephritis. Position of tumor: Several submucous polyps. Size of tumor: Small. Heart condition: Weight, 500 gms. Fatty heart; hypertrophy and dilatation. Associated pathological findings: Chronic interstitial nephritis; cirrhosis of liver; softening of brain.

Autopsy No. 713. White, age 75. Clinical diagnosis: Myocarditis; nephritis; arteriosclerosis. Position of tumor: One submucous. Size of tumor: 1½ x 2 cm. Heart condition. Weight, 250 gms. Fatty degeneration. Associated pathological findings: Chronic interstitial nephritis.

Autopsy No. 764. White, age 55. Clinical diagnosis: Nephritis; endocarditis; arteriosclerosis; pneumonia; pseudobulbar palsy. Position of tumor: One submucous. Size of tumor: 1½ cm. Heart condition: Weight, 320 gms. Fatty infiltration. Associated pathological findings: Chronic diffuse nephritis; arteriosclerosis.

Autopsy No. 811. White, age 78. Clinical diagnosis: Œdema of lungs; arteriosclerosis. Position of tumor: One submucous polyp. Size of tumor: 4 cm. Heart condition: Weight, 280 gms. Brown atrophy; chronic endocarditis. Associated pathological findings: General arteriosclerosis; chronic interstitial and parenchymatous nephritis.

Autopsy No. 852. Black, age 69. Clinical diagnosis, Hemiplegia; chronic interstitial nephritis; mitral valvulitis. Position of tumor: Multiple. Size of tumor: (?). Heart condition: Weight, 290 gms. Chronic endocarditis; aortic sclerosis. Associated pathological findings: Parenchymatous nephritis.

Autopsy No. 867. White, age 43. Clinical diagnosis: Alcoholism; delirium tremens. Position of tumor: One interstitial. Size of tumor: 2 cm. Heart condition: Weight, 260 gms. Fatty heart; chronic valvulitis. Associated pathological findings: Fatty kidneys; colitis; gastritis.

Autopsy No. 891. White, age 29. Clinical diagnosis: Myocarditis; hypertrophy. Position of tumor: Two subperitoneal. Size of tumor: Millet seed. Heart condition: Weight, 360 gms. Mitral stenosis and regurgitation; hypertrophy and dilatation. Associated pathological findings: Subacute hæmorrhagic nephritis. Passive congestion kidneys.

Autopsy No. 903. White, age 61. Clinical diagnosis: Brain tumor. Position of tumor: Four subperitoneal. Size of tumor: Walnut. Heart condition: Weight, 260 gms. Chronic valvulitis. Associated pathological findings: chronic interstitial nephritis.

Autopsy No. 937. Black, age 41. Clinical diagnosis: Myocarditis; cirrhosis of liver; chronic parenchymatous nephritis. Position of tumor: Numerous. Size of tumor: Small. Heart condition: Weight, 520 gms. Hypertrophy; hydropericardium; endocarditis; myocarditis; atheroma of aorta. Associated pathological findings: Syphilitic cirrhosis of liver; ascites; passive congestion of kidneys.

Autopsy No. 989. Black, age 59. Clinical diagnosis: Fibroid of uterus; T. B. of lungs; chronic nephritis; tricuspid regurgitation. Position of tumor: Several interstitial. Size of tumor: 15 x 10 cm. Heart condition: Weight, 380 gms. Chronic myocarditis; chronic endocarditis. Associated pathological findings: Chronic diffuse nephritis.

Autopsy No. 996. White, age 53. Clinical diagnosis: Cancer of stomach. Position of tumor: Several interstitial. Size of tumor: 1 cm. Heart condition: Weight, 240 gms. Moderate fatty degeneration; mitral and aortic valvulitis; atheroma of aorta. Associated pathological findings: Chronic diffuse nephritis; gall-stones.

Autopsy No. 1003. White, age 46. Clinical diagnosis: Nephritis; aneurism of innominate. Position of tumor: One subperitoneal. Size of tumor: Large. Heart condition: Weight, 480 gms. Hypertrophy and dilatation; chronic aortic valvulitis; chronic pericarditis.

Autopsy No. 1010. White, age 47. Clinical diagnosis: Myocarditis; cancer of omentum. Position of tumor: Multiple. Size of tumor: Largest, 3 cm. Heart condition: Weight, 270 gms. Early myocarditis. Associated pathological findings: Cancer of ovary and omentum; chronic diffuse nephritis.

Autopsy No. 1011. Black, age 36. Clinical diagnosis: Myocarditis; hypertrophy; mitral and aortic valvulitis. Position of tumor: Many subserous; one interstitial. Size of tumor: Largest, 4 cm. Heart condition: Weight, 610 gms. Hypertrophy of left ventricle; incompetent mitral and aortic valves. Associated pathological findings: Cirrhosis of liver; chronic diffuse nephritis.

Autopsy No. 1018. White, age 61. Clinical diagnosis: Senility; arteriosclerosis. Position of tumor: One subserous calcified. Size of tumor: Small. Heart condition: Weight, 240 gms. Fatty heart; chronic aortic valvulitis. Associated pathological findings: Pneumonia; tuberculosis of lungs and kidneys; chronic diffuse nephritis.

Autopsy No. 1026. White, age 65. Clinical diagnosis: Hemiplegia; myocarditis; nephritis; arteriosclerosis. Position of tumor: Multiple. Size of tumor: Largest, 5 x 3 cm. Heart condition: Weight, 410 gms. Hypertrophy left ventricle. Associated pathological findings: General arteriosclerosis; pneumonia; chronic diffuse nephritis; cerebral hæmorrhage.

Autopsy No. 1051. Black, age 61. Clinical diagnosis: Hemiplegia; myocarditis; arteriosclero-

sis. Position of tumor: One intraligamentous. Size of tumor: Small. Heart condition: Weight, 520 gms. Hypertrophy; chronic valvulitis; tuberculous pericarditis. Associated pathological findings: General arteriosclerosis; subacute diffuse nephritis; tubercular mediastinal lymph nodes.

Autopsy No. 1056. White, age 66. Clinical diagnosis: Dysentery; enteritis; myocarditis; arteriosclerosis. Position of tumor: One submucous polyp. Size of tumor: Small. Heart condition: Weight, 270 gms. Chronic valvulitis. Associated pathological findings: Ulcerative enteritis.

Autopsy No. 1081. Black, age 34. Clinical diagnosis: Tuberculosis of lungs and peritoneum. Position of tumor: One subperitoneal. Size of tumor: 2 cm. Heart condition: Weight, 310 gms. No lesions. Associated pathological findings: Chronic parenchymatous nephritis; fatty liver.

Autopsy No. 1098. White, age 54. Clinical diagnosis: Tuberculosis of lungs. Position of tumor: One. Size of tumor: $\frac{3}{16}$ in. Heart condition: Weight, 290 gms. No lesions. Associated pathological findings: Tuberculosis of lungs.

Autopsy No. 1100. Black, age 30. Clinical diagnosis: Fibroid of uterus. Position of tumor: One subserous. Size of tumor: Weight, 1630 gms. Heart condition: Weight, 320 gms. Myocarditis. Associated pathological findings: Parenchymatous nephritis.

Autopsy No. 1134. Black, age 35. Clinical diagnosis: Uræmia; parenchymatous nephritis. Position of tumor: Four subperitoneal; two submucous. Size of tumor: 1½ to 2½ cm. Heart condition: Weight, 400 gms. Hypertrophy; chronic valvular disease. Associated pathological findings: Chronic diffuse nephritis; arteriosclerosis; cerebral hæmorrhage.

Autopsy No. 1243. Black, age 42. Clinical diagnosis: Cerebral tumor; nephritis; myocarditis. Position of tumor: Two subperitoneal. Size of tumor: 2 cm. Heart condition: Weight, 290 gms. Chronic myocarditis; chronic valvulitis; sclerosis of coronaries. Associated pathological findings: Arteriosclerosis; chronic interstitial nephritis.

Autopsy No. 1252. Black, age 65. Clinical diagnosis: Hemiplegia; pneumonia; endocarditis; myocarditis; nephritis. Position of tumor: Many subperitoneal. Size of tumor: Large and small. Heart condition: Weight, 320 gms. Sclerotic aortic valve; atheroma of aorta. Associated pathological findings: Chronic interstitial nephritis.

Autopsy No. 1254. Indian, age 57. Clinical diagnosis: Pneumonia; chronic nephritis. Position of tumor: One. Size of tumor: Small. Heart condition: Weight, 280 gms. Muscle brown and flabby; slight sclerosis of mitral valve. Associated pathological findings: Pneumonia; gall-stones; diffuse nephritis.

Autopsy No. 1313. White, age 60. Clinical diagnosis: Arteriosclerosis; uræmia. Position of tumor: Two subperitoneal. Size of tumor: Chestnut. Heart condition: Weight, 520 gms. Fatty; dilatation and hypertrophy; sclerosis of aortic valve. Associated pathological findings: Tumors of right kidney, sternum, left lung; chronic parenchymatous nephritis.

Autopsy No. 1320. White, age 104. Clinical diagnosis: Myocarditis; nephritis; senility. Position of tumor: One. Size of tumor: Egg. Heart condition: Remarkably normal heart for age. Associated pathological findings: Pneumonia; stone in kidney; mystic kidney.

Autopsy No. 1324. Black, age 42. Clinical diagnosis: Mitral and aortic disease. Position of tumor: One subperitoneal. Size of tumor: Small. Heart condition: Weight, 600 gms. Hypertrophy and dilatation. Associated pathological findings: General arteriosclerosis; chronic interstitial nephritis.

Autopsy No. 1350. Black, age 40. Clinical diagnosis: Pulmonary and meningeal tuberculosis. Position of tumor: Multiple. Size of tumor: (?). Heart condition: Weight, 230 gms. Slight pulmonic sclerosis. Associated pathological findings: Miliary tuberculosis.

Autopsy No. 1388. Black, age 50. Clinical diagnosis: Acute dilatation of heart; laryngeal growth. Position of tumor: Multiple. Size of tumor: Large. Heart condition: Weight, 340 gms. Acute dilatation; myocarditis. Associated pathological findings: Gumma of lungs and vocal cords; passive congestion of kidneys.

Autopsy No. 1430. White, age 74. Clinical diagnosis: Myocarditis; arteriosclerosis; diffuse nephritis. Position of tumor: One subperitoneal nodule. Size of tumor: 1 cm. Heart condition: Weight, 530 gms. Chronic myocarditis; chronic indurated valvulitis. Associated pathological findings: General arteriosclerosis.

Autopsy No. 1476. White, age 65. Clinical diagnosis: Cerebral hæmorrhage; myocarditis; chronic diffuse nephritis; cardiac dilatation. Position of tumor: One interstitial nodule. Size of tumor: Pigeon egg. Heart condition: Weight (?). Hypertrophy and dilatation; fatty degeneration of heart. Associated pathological findings: Chronic diffuse nephritis; gall-stones; general arteriosclerosis; œdema of the brain.

Autopsy No. 1488. White, age 55. Clinical diagnosis: Pneumonia; uræmia. Position of tumor: Two interstitial. Size of tumor: 3 and 7 cm. Heart condition: Weight, 300 gms. Fatty degeneration. Associated pathological findings: Chronic diffuse nephritis; parenchymatous degeneration of liver; acute pancreatitis.

Autopsy No. 1504. White, age 60. Clinical diagnosis: Myocarditis; arteriosclerosis; chronic valvulitis; chronic diffuse nephritis. Position of tumor: Two subperitoneal. Size of tumor: 2 and 4 cm. Heart condition: Weight, 350 gms. Fatty degeneration; sclerosis of mitral and aortic valves; atheroma of aorta.

Autopsy No. 1525. Black, age 49. Clinical diagnosis: Apoplexy; myocarditis; pneumonia.

Position of tumor: Multiple; some necrotic. Size of tumor: 3 to 9 cm. Heart condition: Weight, 556 gms. Cloudy swelling. Associated pathological findings: Chronic diffuse nephritis; gall-stones; head not opened.

Autopsy No. 1526. White, age 81. Clinical diagnosis: Myocarditis; bronchitis; chronic interstitial nephritis. Position of tumor: Several submucous nodes. Size of tumor: 4 cm. Heart condition: Weight, 320 gms. Chronic myocarditis. Associated pathological findings: Chronic interstitial nephritis; fibroma of left kidney; hæmorrhage; cystitis.

Autopsy No. 1528. White, age 72. Clinical diagnosis: Cancer of uterus; myocarditis; diffuse nephritis; arteriosclerosis. Position of tumor: One large subperitoneal node. Many small submucous nodes which are gangrenous. Size of tumor: 2 to 6 cm. Heart condition: Weight, 300 gms. Fatty degeneration; atheroma of aorta.

Autopsy No. 1615. White, age 47. Clinical diagnosis: Pneumonia; uræmia. Position of tumor: One small submucous nodule. Size of tumor: Small. Heart condition: Weight, 250 gms. Cloudy swelling of myocardium. Associated pathological findings: Acute pneumonia; chronic interstitial nephritis.

Autopsy No. 1680. Black, age 50. Clinical diagnosis: Hypertrophy and dilatation of heart; myocarditis; chronic valvular disease; anasarca. Position of tumor: Three subperitoneal nodules. Size of tumor: 1½ cm. Heart condition: Weight, 840 gms. Valvular disease; hypertrophy. Associated pathological findings: Chronic nephritis; acute hæmorrhagic pancreatitis.

Autopsy No. 1707. White, age 86. Clinical diagnosis: Hemiplegia; aortic disease; arteriosclerosis. Position of tumor: Two subserous. Size of tumor: 1½ and ½ cm. Heart condition: Weight, 600 gms. Dilatation; sclerosis of aortic mitral and tricuspid valves. Associated pathological findings: General arteriosclerosis.

Autopsy No. 1718. White, age 41. Clinical diagnosis: General peritonitis; pneumonia. Position of tumor: One subserous. Size of tumor: ½ in. Heart condition: Weight, 320 gms. Cloudy swelling. Associated pathological findings: Acute pelvic peritonitis; acute parenchymatous nephritis.

Autopsy No. 1744. Black, age 45. Clinical diagnosis: Died two hours after admission; coroner's case. Position of tumor: One submucous nodule. Size of tumor: Marble. Heart condition: Weight, 580 gms. Hypertrophy and dilatation. Associated pathological findings: Acute nephritis: chronic diffuse nephritis; arteriosclerosis; cerebral hæmorrhage.

Autopsy No. 1759. Black, age 38. Clinical diagnosis: Endocarditis valvulitis; chronic interstitial nephritis. Position of tumor: Four subperitoneal nodules. Size of tumor: Small. Heart condition: Weight, 480 gms. Mitral valvulitis; hypertrophy and dilatation. Associated pathological findings: General arteriosclerosis; chronic interstitial nephritis; cancer of gall-bladder.

Autopsy No. 1760. White, age 43. Clinical diagnosis: Cerebral hæmorrhage. Position of tumor: One subperitoneal nodule. Size of tumor: 2 cm. Heart condition: Weight, 380 gms. Hypertrophy and dilatation; fatty degeneration. Associated pathological findings: Traumatic cerebral hæmorrhage.

Autopsy No. 1800. Black, age 38. Clinical diagnosis: Malignant tumor of bladder; tuberculosis of lungs. Position of tumor: One submucous. Size of tumor: Small. Heart condition: Weight, 300 gms. Cloudy swelling of myocardium. Associated pathological findings: Œdema of lungs.

Autopsy No. 1830. Black, age 69. Clinical diagnosis: Mitral and aortic disease; tuberculosis of lungs. Position of tumor: Interstitial. Size of tumor: Small. Heart condition: Weight, 310 gms. Mitral and aortic incompetence; tricuspid stenosis; chronic myocarditis. Associated pathological findings: Chronic diffuse nephritis; labor pneumonia.

Autopsy No. 1850. White, age 50. Clinical diagnosis: Progressive pernicious anæmia. Position of tumor: One submucous. Size of tumor: 1½ cm. Heart condition: Weight, 250 gms. Mitral and aortic sclerosis; fatty degeneration. Associated pathological findings: Atrophy of intestinal mucosa; healed ulcer of colon; fatty liver; fatty degeneration of kidneys.

Autopsy No. 1899. Black, age 80. Clinical diagnosis: (?). Position of tumor: One interstitial. Size of tumor: 8 x 6 cm. Heart condition: Weight, 250 gms. Fibroid myocarditis; fatty degeneration. Associated pathological findings: Chronic interstitial nephritis; hypernephroma right kidney; acute miliary tuberculosis.

Autopsy No. 1919. White, age 55. Clinical diagnosis: Uræmia. Position of tumor: One interstitial calcified. Size of tumor: 2½ cm. Heart condition: Weight, 500 gms. Fatty degeneration; atheroma of aorta. Associated pathological findings: Chronic interstitial nephritis with superimposed acute process.

Autopsy No. 1921. Black, age 28. Clinical diagnosis: Valvular heart disease. Position of tumor: Two interstitial. Size of tumor: 7 cm. Heart condition: Weight, 300 gms. Early fibroid myocarditis; atheroma of aorta. Associated pathological findings: Chronic interstitial nephritis; abscess of liver.

Autopsy No. 1937. White, age 61. Clinical diagnosis: Atrophic cirrhosis of liver; arteriosclerosis; tuberculosis of lungs. Position of tumor: Several interstitial. Size of tumor: Small. Heart condition: Weight, 260 gms. Fibroid myocarditis; fatty degeneration. Associated pathological findings: Atrophic cirrhosis of liver; chronic interstitial nephritis; emphysema of lungs.

Autopsy No. 1938. Black, age 59. Clinical diagnosis: Fibroid of uterus. Position of tumor: Large multiple. Size of tumor: 6 to 11 cm. Heart

condition: Weight, 370 gms. Hypertrophy; aortic and mitral stenosis. Associated pathological findings: Chronic interstitial nephritis with superimposed acute process; pneumonia; not operated on because of kidney condition.

Autopsy No. 1951. White, age 40. Clinical diagnosis: Coroner's case. Position of tumor: Numerous subserous and interstitial. Size of tumor: Largest 4 cm. Heart condition: Weight, 250 gms. Fatty degeneration; dilated left ventricle. Associated pathological findings: Glioma of brain.

Autopsy No. 1966. White, age 44. Clinical diagnosis: Cancer of stomach; mitral disease; hypertrophy; tuberculosis of lungs. Position of tumor: One submucous. Size of tumor: 1 cm. Heart condition: Weight, 220 gms. Mitral and aortic valvulitis. Associated pathological findings: Chronic interstitial nephritis; cancer of stomach.

Autopsy No. 1979. White, age 42. Clinical diagnosis: Myocarditis; acute nephritis. Position of tumor: One subserous; sarcomatous degeneration. Size of tumor: 2 cm. Heart condition: Weight, (?). Dilatation; mitral sclerosis. Associated pathological findings: Acute parenchymatous nephritis; anasarca.

Autopsy No. 1980. White, age 31. Clinical diagnosis: Dilatation of heart, acute; encephalitis; chronic nephritis. Position of tumor: One subserous. Size of tumor: Almond. Heart condition: Weight, 430 gms. Hypertrophy. Associated pathological findings: Chronic interstitial nephritis; early arteriosclerosis.

Autopsy No. 1991. Black, age 45. Clinical diagnosis: Cardiac dilatation and hypertrophy; anasarca. Position of tumor: Two subserous. Size of tumor: 15 cm. Heart condition: Weight, 550 gms. Dilatation and hypertrophy; sclerosis of mitral valve. Associated pathological findings: Chronic parenchymatous nephritis.

Autopsy No. 2022. White, age 63. Clinical diagnosis: Hemiplegia. Position of tumor: Two submucous. Size of tumor: 4 cm. Heart condition: Weight, 320 gms. Chronic interstitial myocarditis. Associated pathological findings: chronic interstitial nephritis; arteriosclerosis.

Autopsy No. 2058. White, age 68. Clinical diagnosis: Tabes dorsalis; chronic interstitial nephritis. Position of tumor: One subperitoneal. Size of tumor: (?). Heart condition: Weight, 260 gms. Chronic interstitial myocarditis; chronic endocarditis; sclerosis of mitral and aortic valves. Associated pathological findings: Chronic interstitial nephritis; general sclerotic changes in all organs.

Autopsy No. 2118. Black, age 30. Clinical diagnosis: Chronic myocarditis; arteriosclerosis; functional murmur; tuberculosis of lungs; chronic diffuse nephritis. Position of tumor: One subperitoneal. Size of tumor: 7½ x 5 cm. Heart condition: Weight, 250 gms. Muscle flabby, normal otherwise. Associated pathological findings: Chronic parenchymatous nephritis; congestion of lungs.

Autopsy No. 2125. Black, age 21. Clinical diagnosis: Puerperal sepsis. Position of tumor: Few subperitoneal. Size of tumor: Pea to marble. Heart condition: Weight, 260 gms. Cloudy swelling of myocardium; subendocardial hæmorrhage. Associated pathological findings: Pelvic peritonitis.

Autopsy No. 2132. Black, age 51. Clinical diagnosis: Ovarian cyst; ascites; myocarditis. Position of tumor: Four subperitoneal. Size of tumor: Largest 3 cm. Heart condition: Weight, 600 gms. Hypertrophy; dilatation; chronic mitral and tricuspid valvulitis. Associated pathological findings: Cirrhosis of liver; ovarian cyst; acute pyosalpinx; passive congestion of kidneys.

Autopsy No. 2160. Black, age 65. Clinical diagnosis: Chronic nephritis; mitral and aortic disease. Position of tumor: One interstitial. Size of tumor: ½ cm. Heart condition: Weight, 470 gms. Hypertrophy and dilatation; chronic mitral and aortic disease; chronic endocarditis. Associated pathological findings: chronic diffuse nephritis.

Autopsy No. 2183. White, age 55. Clinical diagnosis: Aortic disease; arteriosclerosis; tubercular peritonitis. Position of tumor: Multiple small nodules; calcareous. Size of tumor: Largest 3½ cm. Heart condition: Weight, 480 gms. Hypertrophy of left ventricle; dilated left auricle; chronic mitral valvulitis. Associated pathological findings: General arteriosclerosis; tubercular peritonitis.

Autopsy No. 2186. Black, age 46. Clinical diagnosis: Uræmia; mitral disease; chronic diffuse nephritis. Position of tumor: Cystic fibroid. Size of tumor: Weight, 1215 gms. Heart condition: 425 gms. Hypertrophy; calcified mitral valve atheroma of aorta. Associated pathological findings: Chronic interstitial and parenchymatous nephritis; cerebral hæmorrhage.

Autopsy No. 2220. White, age 44. Clinical diagnosis: Pneumonia. Position of tumor: Multiple. Size of tumor: Largest 4 cm. Heart condition: Weight, (?). Fat infiltration and cloudy swelling of myocardium; sclerosis of mitral and aortic valves. Associated pathological findings: General arteriosclerosis.

Autopsy No. 2258. Black, age 38. Clinical diagnosis: Anasarca; nephritis; œdema of lungs. Position of tumor: Two subserous nodules. Size of tumor: Small. Heart condition: Weight, (?). Hypertrophy and dilatation; chronic endocarditis. Associated pathological findings: Chronic interstitial nephritis.

Autopsy No. 2326. White, age 61. Clinical diagnosis: Sarcoma of liver. Position of tumor: Subperitoneal. Size of tumor: 5 cm. Heart condition: Weight, 260 gms. Muscle pale and soft; chronic mitral valvulitis. Associated pathological findings: Primary cancer of gall-bladder; gall-stones; small white kidneys.

Autopsy No. 2334. White, age 66. Clinical diagnosis: Hemiplegia; pneumonia; myocarditis. Position of tumor: Many small interstitial. Size of tumor: Small. Heart condition: Weight, 235

gms. Acute pericarditis; sclerosis of mitral and aortic valves coronary vessels. Associated pathological findings: Chronic interstitial nephritis; cranium not opened.

Autopsy No. 2346. White, age 60. Clinical diagnosis: Hemiplegia; myocarditis; chronic valvulitis. Position of tumor: One subperitoneal. Size of tumor: 1 cm. Heart condition: Weight, 565 gms. Hypertrophy and dilatation; sclerosis of mitral valve. Associated pathological findings: Chronic interstitial nephritis.

Autopsy No. 2349. White, age 67. Clinical diagnosis: Hemiplegia; valvulitis; dilatation; pneumonia. Position of tumor: One subperitoneal polyp. Size of tumor: ½ in. Heart condition: Weight, 415 gms. Hypertrophy; brown atrophy. Associated pathological findings: Chronic interstitial nephritis.

Autopsy No. 2350. White, age 67. Clinical diagnosis: Paralysis agitans. Position of tumor: Many subperitoneal nodules. Size of tumor: Small. Heart condition: Weight, 325 gms. Muscle normal; atheroma of all valves. Associated pathological findings: General arteriosclerosis.

Autopsy No. 2374. White, age 56. Clinical diagnosis: Diplegia. Position of tumor: Many subperitoneal nodules. Size of tumor: Pea to walnut. Heart condition: Weight, 300 gms. Normal.

Autopsy No. 2390. White, age 78. Clinical diagnosis: Pneumonia; arthritis deformans. Position of tumor: One submucous calcified. Size of tumor: 4 cm. Heart condition: Weight, 400 gms. Sclerosis of valves.

Autopsy No. 2394. Black, age 29. Clinical diagnosis: Mitral and aortic disease; nephritis. Position of tumor: Two interstitial. Size of tumor: Pea. Heart condition: Weight, 500 gms. Hypertrophy and dilatation; fatty degeneration of muscle; chronic mitral and aortic valvulitis. Associated pathological findings: Cyanotic induration of kidneys.

Autopsy No. 2399. White, age 63. Clinical diagnosis: Pneumonia. Position of tumor: Several subperitoneal. Size of tumor: 1 to 4 cm. Heart condition: Weight, 265 gms. Cloudy swelling of myocardium; sclerosis of mitral and aortic valves. Associated pathological findings: Chronic interstitial nephritis.

Autopsy No. 2401. White, age 65. Clinical diagnosis: Cerebral thromboses. Position of tumor: Several interstitial calcified. Size of tumor: Pea to marble. Heart condition: Weight, 320 gms. Fatty degeneration; sclerosis of mitral and aortic valves. Associated pathological findings: Syphilitic arteriosclerosis.

Autopsy No. 2418. Black, age 42. Clinical diagnosis: Paresis. Position of tumor: One subperitoneal. Size of tumor: 2 cm. Heart condition: Weight, 260 gms. Normal.

Autopsy No. 2494. Black, age 50. Clinical diagnosis: Myocarditis. Position of tumor: Two subperitoneal. Size of tumor: 1 cm. Heart condition: Weight, 300 gms. Fatty with moderate fibrosis; dilatation of left ventricle; chronic mitral and aortic valvulitis. Associated pathological findings: Chronic interstitial nephritis.

Autopsy No. 2527. Black, age 45. Clinical diagnosis: Uterine fibroid; acute dilatation of heart; diffuse nephritis; sent to hospital as case of eclampsia. Position of tumor: Multiple tumors. Size of tumor: Large. Heart condition: Weight, 510 gms. Chronic interstitial myocarditis; dilatation left ventricle; chronic aortitis. Associated pathological findings: Chronic interstitial nephritis; œdema of both lungs. Died day of admission to hospital of uræmia. No operation.

Autopsy No. 2549. Black, age 26. Clinical diagnosis: Parenchymatous nephritis; myocarditis; acute dilatation; anasarca. Position of tumor: One submucous. Size of tumor: 3 cm. Heart condition: Weight, 440 gms. Dilated right auricle. Associated pathological findings: Atrophic cirrhosis of liver; chronic interstitial nephritis; general œdema.

Autopsy No. 2557. White, age 84. Clinical diagnosis: Cancer of stomach. Position of tumor: Four interstitial; uterus atrophied. Size of tumor: 2½ cm. Heart condition: Weight, 275 gms. Brown atrophy; general sclerotic changes. Associated pathological findings: General arteriosclerosis; no cancer.

Autopsy No. 2581. White, age 65. Clinical diagnosis: Acute myocarditis. Position of tumor: One interstitial nodule. Size of tumor: Small. Heart condition: Weight, 745 gms. Hypertrophy and dilatation. Associated pathological findings: Chronic interstitial nephritis; atrophic cirrhosis of liver; gall-stones.

Autopsy No. 2590. Black, age 40. Clinical diagnosis: Myocarditis; aortic disease; diffuse nephritis. Position of tumor: Multiple. Size of tumor: (?). Heart condition: Weight, 475 gms. Acute endocarditis superimposed on chronic process; atheroma of aorta. Associated pathological findings: Diffuse nephritis.

Autopsy No. 2591. Black, age 63. Clinical diagnosis: Hemiplegia; uræmia; diffuse nephritis; myocarditis; arteriosclerosis. Position of tumor: Several interstitial calcified. Size of tumor: 3 cm. Heart condition: Weight, 455 gms. Chronic adhesive pericarditis; hypertrophy and dilatation; mitral stenosis; aortic endocarditis. Associated pathological findings: Chronic diffuse nephritis; gall-stones.

Autopsy No. 2594. White, age 32. Clinical diagnosis: General carcinomatosis. Position of tumor: One subperitoneal. Size of tumor: Small. Heart condition: Weight, 185 gms. Smaller than normal; sclerosis of coronaries; chronic pericarditis; sclerotic mitral and aortic valves. Associated pathological findings: General carcinomatosis; chronic interstitial nephritis.

Autopsy No. 2597. Black, age 55. Clinical diagnosis: Cardiac hypertrophy with dilatation. Position of tumor: One interstitial. Size of tumor:

2 cm. Heart condition: Weight, (?) gms. Hypertrophy; right auricle dilated; sclerosis of aortic and mitral valves. Associated pathological findings: Atrophic cirrhosis of liver; chronic interstitial nephritis.

Autopsy No. 2619. White, age (?). Clinical diagnosis: Uræmia; hypertrophy of heart. Position of tumor: One interstitial. Size of tumor: 2 cm. Heart condition: Weight, 360 gms. Muscle pale, not firm; hypertrophy and dilatation of left ventricle. Associated pathological findings: Chronic diffuse nephritis.

Autopsy No. 2627. Black, age 59. Clinical diagnosis: Hemiplegia; arteriosclerosis. Position of tumor: One subperitoneal. Size of tumor: Fist. Heart condition: Weight, 345 gms. Hypertrophy; sclerotic aortic and mitral valves. Associated pathological findings: Chronic interstitial nephritis; cerebral hæmorrhage; general arteriosclerosis.

Autopsy No. 2660. White, age 59. Clinical diagnosis: Cardiac hypertrophy and dilatation; mitral regurgitation. Position of tumor: Few interstitial. Size of tumor: Small. Heart condition: Weight, 580 gms. Hypertrophy and dilatation; pale muscle.

Autopsy No. 2674. Black, age 44. Clinical diagnosis: Valvular heart disease; chronic nephritis; anasarca. Position of tumor: several interstitial and submucous. Size of tumor: small. Heart condition: Weight, (?) gms. Hypertrophy and dilatation; sclerotic valves and coronary arteries. Associated pathological findings: Arteriosclerosis; nutmeg liver; cyanotic induration of kidneys.

Autopsy No. 2681. White, age 38. Clinical diagnosis: Hemiplegia; status epilepticus. Position of tumor: Few interstitial. Size of tumor: Very small. Heart condition: Weight, (?) gms. Chronic myocarditis; sclerotic aortic and mitral valves. Associated pathological findings: Chronic interstitial nephritis; syphilitic liver.

Autopsy No. 2692. White, age 57. Clinical diagnosis: Pneumonia; myocarditis. Position of tumor: One interstitial. Size of tumor: Small. Heart condition: Weight, 356 gms. Normal; sclerosis of aorta. Associated pathological findings: Pneumonia; chronic interstitial nephritis.

Autopsy No. 2697. Black, age 55. Clinical diagnosis: Sarcoma of femur; myocardial degeneration. Position of tumor: One subperitoneal, calcified. Size of tumor: Very large. Heart condition: Weight, 375 gms. Small and firm; small sarcomatous nodule. Associated pathological findings: Sarcoma of femur.

Autopsy No. 2699. White, age 79. Clinical diagnosis: Apoplexy; pneumonia; arteriosclerosis. Position of tumor: One subperitoneal polyp. Size of tumor: 3 x 5 cm. Heart condition: Weight, 260 gms. Chronic interstitial myocarditis; sclerosis of mitral and aortic valves and coronary arteries. Associated pathological findings: General arteriosclerosis; chronic interstitial nephritis; cerebral œdema.

Autopsy No. 2749. White, age 61. Clinical diagnosis: Pneumonia; meningitis; valvular disease of heart. Position of tumor: One subperitoneal, calcified. Size of tumor: Baseball. Heart condition: Weight, 340 gms. Dilatation; chronic mitral and aortic sclerosis; calcareous coronaries. Associated pathological findings: general arteriosclerosis.

Autopsy No. 2753. Black, age 58. Clinical diagnosis: Cerebral thrombosis; arteriosclerosis. Position of tumor: Several submucous. Size of tumor: Small. Heart condition: Weight, 300 gms. Slight chronic myocarditis. Associated pathological findings: Chronic parenchymatous nephritis; old cerebral hæmorrhage.

Autopsy No. 2760. Black, age 61. Clinical diagnosis: Meningo-myelitis. Position of tumor: One interstitial. Size of tumor: Small. Heart condition: Weight, 205 gms. Sclerosis of valves and coronary arteries; syphilitic aortitis. Associated pathological findings: Chronic interstitial nephritis.

Autopsy No. 2766. Black, age 50. Clinical diagnosis: Tubercular meningitis. Position of tumor: Few. Size of tumor: Small. Heart condition: Weight, 450 gms. Cloudy swelling; mitral sclerosis. Associated pathological findings: General arteriosclerosis; chronic interstitial nephritis; diffuse meningeal hæmorrhage.

Autopsy No. 2768. White, age 53. Clinical diagnosis: Diabetes mellitus. Position of tumor: One submucous. Size of tumor: Lemon. Heart condition: Weight, 310 gms. Brown atrophy; chronic myocarditis; slight mitral, aortic and coronary sclerosis. Associated pathological findings: (?)

Autopsy No. 2773. Black, age 53. Clinical diagnosis: Tuberculosis of lungs; pelvic tumor. Position of tumor: Multiple; calcified. Size of tumor: Largest, Two fists. Heart condition: Weight, 370 gms. Chronic myocarditis; fatty myocardium; sclerosis of mitral and aortic valves, and aorta and coronaries. Associated pathological findings: Œdema of lungs; chronic interstitial nephritis.

Autopsy No. 2780. Black, age 30. Clinical diagnosis: Hæmophilia; valvulitis. Position of tumor: Few interstitial nodules. Size of tumor: Small. Heart condition: Weight, 350 gms. Chronic fibroid; myocarditis. Associated pathological findings: Hypernephroma of left kidney.

Autopsy No. 2781. White, age 52. Clinical diagnosis: Cancer of liver; tuberculosis of lungs. Position of tumor: One subperitoneal. Size of tumor: 1 cm. Heart condition: Weight, 220 gms. Fatty degeneration. Associated pathological findings: Healed tuberculosis of lungs; cancer of gallbladder.

Autopsy No. 2818. Black, age 53. Clinical diagnosis: Cardiac dilatation; myocarditis. Position of tumor: Multiple. Size of tumor: Largest, 20 x 17 cm. Heart condition: Weight, 230 gms. Valves normal; slight sclerosis of coronaries; myo-

cardium pale and flabby. Associated pathological findings: Mixed tumor of carotid with metastases to liver; chronic passive congestion of kidneys.

Autopsy No. 2826. White, age 49. Clinical diagnosis: Mitral and tricuspid regurgitation. Position of tumor: Two nodules. Size of tumor: Pea and acorn. Heart condition: Weight, 460 gms. Chronic pericarditis; hypertrophy; chronic mitral and aortic sclerosis. Associated pathological findings: Chronic parenchymatous nephritis.

Autopsy No. 2856. White, age 74. Clinical diagnosis: Myocardial degeneration, arteriosclerosis. Position of tumor: Two subperitoneal. Size of tumor: Small. Heart condition: Weight, 410 gms. Dilatation of right heart. Associated pathological findings: General arteriosclerosis.

Autopsy No. 2858. White, age 67. Clinical diagnosis: Senile dementia; pneumonia. Position of tumor: One nodule. Size of tumor: 3 cm. Heart condition: Weight, 360 gms. Cloudy swelling. Associated pathological findings: General arteriosclerosis.

Autopsy No. 2860. Black, age 38. Clinical diagnosis: Myocarditis; mitral regurgitation; chronic parenchymatous nephritis. Position of tumor: Two subperitoneal calcified. Size of tumor: 8 cm. Heart condition: Weight, 500 gms. Hypertrophy and dilatation; chronic aortic endocarditis. Associated pathological findings: Cirrhosis of liver; chronic parenchymatous nephritis.

Autopsy No. 2869. White, age 48. Clinical diagnosis: Status epilepticus. Position of tumor: One submucous polyp. Size of tumor: 3½ cm. Heart condition: Weight, 480 gms. Chronic endocarditis; hypertrophy; atheroma of aorta. Associated pathological findings: Chronic diffuse nephritis; tuberculosis of lungs.

TABLE II

SHOWING VARIOUS HEART LESIONS FOUND ON POST-MORTEM EXAMINATION

| | Fibroids, 100 cases | Other Conditions, 100 cases |
|---|---|---|
| Normal hearts | 12 | 18 |
| Sclerotic mitral valves | 57 | 44 |
| Sclerotic aortic valves | 45 | 45 |
| Sclerotic tricuspid valves | 9 | 3 |
| Sclerotic pulmonic valves | 2 | .. |
| Chronic pericarditis | 8 | 2 |
| Chronic myocarditis | 15 | 14 |
| Chronic endocarditis | 2 | 2 |
| Epicardial plaques | 5 | 6 |
| Sclerosis of coronaries | 14 | 7 |
| Atheroma of aorta | 2 | 19 |
| Hypertrophy | 34 | 29 |
| Dilatation | 9 | 21 |
| Fatty heart | 14 | 18 |
| Brown atrophy | 7 | 3 |
| Cloudy swelling | 2 | .. |
| Aneurism | 1 | 5 |
| Atrophy | 2 | .. |
| Acute endocarditis | 1 | .. |
| Acute pericarditis | 2 | 4 |
| Acute aortic disease | 1 | 2 |
| Acute mitral disease | .. | 1 |
| Acute tricuspid disease | .. | 1 |
| Hydropericardium | 6 | 1 |
| Hæmopericardium | .. | 1 |
| Pericardial ecchymosis | 1 | .. |
| Subendocardial hæmorrhage | .. | 1 |
| Œdema of the myocardium | 1 | .. |
| Myxoma of the heart | 1 | .. |
| Lipomatosis pericardii | .. | 3 |
| Total lesions | 241 | 232 |

TABLE III

(Age, from twenty to twenty-nine years)

| | Fibroids, 2 cases | Other Conditions[1] |
|---|---|---|
| Normal | 2 | .. |
| Acute endocarditis | .. | 1 |
| Sclerosis of coronaries | .. | 1 |
| Total lesions | 2 | 2 |

[1] Multiple neuritis; gangrene of lung.

TABLE IV

(Age, from thirty to thirty-nine years)

| | Fibroids, 13 cases | Other Conditions[1] |
|---|---|---|
| Normal | 5 | 8 |
| Hypertrophy | 4 | 1 |
| Dilatation | 2 | .. |
| Chronic mitral disease | 5 | 1 |
| Chronic aortic disease | 2 | 1 |
| Sclerosis of coronaries | 2 | .. |
| Hydropericardium | 2 | .. |
| Sclerosis of tricuspid | 2 | .. |
| Pericardial ecchymosis | 1 | .. |
| Chronic pericarditis | 1 | .. |
| Acute pericarditis | 1 | .. |
| Chronic myocarditis | 2 | 2 |
| Epicardial plaques | 1 | 1 |
| Chronic endocarditis | 1 | .. |
| Fatty heart | 1 | 1 |
| Atrophy of heart | 1 | .. |
| Atheroma of aorta | .. | 1 |
| Total lesions | 28 | 8 |

[1] Cerebral tumor, pyosalpinx, tuberculous meningitis, miliary tuberculosis, gall-stones, pulmonary tuberculosis, uræmia, cancer of breast, syphilis, cancer of rectum, gastric ulcer, pneumonia.

TABLE V

(Age, from forty to forty-nine years)

| | Fibroids, 25 cases | Other Conditions[1] |
|---|---|---|
| Normal | 7 | 5 |
| Dilatation | 3 | 4 |
| Hypertrophy | 7 | 5 |
| Chronic aortic disease | 11 | 8 |
| Chronic mitral disease | 9 | 13 |
| Fatty heart | 3 | 3 |
| Epicardial plaques | 1 | 1 |
| Chronic myocarditis | 4 | 3 |
| Chronic pericarditis | 1 | 2 |
| Chronic endocarditis | 1 | 1 |
| Sclerosis of coronaries | 1 | 2 |
| Cloudy swelling | 1 | .. |
| Aneurism | 1 | 2 |
| Hydropericardium | 1 | .. |
| Small heart | 1 | .. |
| Atheroma of aorta | .. | 4 |

| | | |
|---|---|---|
| Acute aortic disease | .. | 1 |
| Acute tricuspid disease | .. | 1 |
| Brown atrophy | .. | 1 |
| Acute pericarditis | .. | 1 |
| Hæmopericardium | .. | 1 |
| Total lesions | 45 | 53 |

[1] Cancer of pancreas, chronic parenchymatous nephritis, pulmonary tuberculosis, acute nephritis, apoplexy, aortic valvular disease, pneumonia, miliary tuberculosis, aortic aneurism, pelvic peritonitis, diabetes, acute pericarditis, pachymeningitis, purpura, tabes dorsalis, cancer of uterus, erysipelas.

TABLE VI

(Age, from fifty to fifty-nine years)

| | Fibroids, 27 cases | Other Conditions[1] |
|---|---|---|
| Normal | .. | 2 |
| Hypertrophy | 10 | 8 |
| Dilatation | 1 | 12 |
| Chronic mitral disease | 17 | 9 |
| Chronic aortic disease | 14 | 12 |
| Chronic tricuspid disease | 1 | 1 |
| Sclerosis of coronaries | 4 | 2 |
| Epicardial plaques | 2 | 3 |
| Chronic pulmonic disease | 1 | .. |
| Hydropericardium | 1 | 1 |
| Fatty heart | 4 | 6 |
| Brown atrophy | 2 | 2 |
| Myxoma of heart | 1 | .. |
| Atheroma of aorta | 1 | 4 |
| Chronic pericarditis | 3 | .. |
| Chronic myocarditis | 3 | 5 |
| Œdema of myocardium | 1 | .. |
| Acute pericarditis | .. | 1 |
| Aneurism | .. | 1 |
| Total lesions | 66 | 67 |

[1] Pernicious anæmia, meningomyelitis, chronic interstitial nephritis, pneumonia, myocarditis, adiposa dolorosa, tabes dorsalis, aneurism, pulmonary tuberculosis, uræmia, pachymeningitis, apoplexy, cancer of vagina, valvular heart disease, myxœdema, septic cholangeitis.

TABLE VII

(Age, from sixty to sixty-nine years)

| | Fibroids, 17 cases | Other Conditions[1] |
|---|---|---|
| Normal | .. | 1 |
| Hypertrophy | 6 | 8 |
| Dilatation | 2 | 3 |
| Fatty heart | 5 | 4 |
| Chronic mitral disease | 13 | 13 |
| Chronic aortic disease | 6 | 13 |
| Chronic tricuspid disease | 4 | 1 |
| Sclerosis of coronaries | 2 | 3 |
| Atheroma of aorta | 1 | 5 |
| Chronic myocarditis | 2 | 3 |
| Hydropericardium | 1 | .. |
| Chronic pericarditis | 3 | 2 |
| Brown atrophy | 3 | .. |
| Cloudy swelling | 1 | .. |
| Epicardial plaques | .. | 1 |
| Chronic endocarditis | .. | 1 |
| Lipomatosis pericardii | .. | 3 |
| Acute mitral disease | .. | 1 |
| Acute aortic disease | .. | 1 |
| Total lesions | 49 | 62 |

[1] Chronic interstitial nephritis, fractured thigh, cancer of vagina, emphysema of lungs, cancer of stomach, pneumonia, apoplexy, gall-stones, senile dementia, rheumatism, valvular heart disease, abscess of kidney.

TABLE VIII

(Age, from seventy to seventy-nine years)

| | Fibroids, 14 cases | Other Conditions[1] |
|---|---|---|
| Hypertrophy | 7 | 7 |
| Dilatation | 1 | 2 |
| Chronic mitral disease | 12 | 8 |
| Chronic aortic disease | 11 | 10 |
| Chronic tricuspid disease | 2 | .. |
| Chronic pulmonic disease | 1 | .. |
| Sclerosis of coronaries | 3 | .. |
| Acute aortic disease | 1 | .. |
| Epicardial plaques | 1 | .. |
| Chronic myocarditis | 4 | 1 |
| Chronic pericarditis | 1 | .. |
| Fatty heart | 1 | 4 |
| Brown atrophy | 2 | .. |
| Hydropericardium | 1 | .. |
| Atheroma of aorta | .. | 4 |
| Aneurism of aorta | .. | 2 |
| Subendocardial hæmorrhage | .. | 1 |
| Total lesions | 48 | 39 |

[1] Pneumonia, chronic parenchymatous nephritis, cancer of stomach, senility, pulmonary tuberculosis, uræmia, aneurism of aorta, abscess of kidney, chronic interstitial nephritis.

TABLE IX

(Age, eighty years and over)

| | Fibroids, 1 case | Pneumonia |
|---|---|---|
| Chronic aortic disease | 1 | 1 |
| Sclerosis of coronaries | 1 | .. |
| Chronic tricuspid disease | .. | 1 |
| Atheroma of aorta | .. | 1 |
| Total lesions | 2 | 3 |

TABLE X

(Age, twenty to thirty-nine years)

| | Fibroids, 28 cases | Other Conditions[1] |
|---|---|---|
| Normal | 9 | 10 |
| Hypertrophy | 8 | 2 |
| Dilatation | 4 | 1 |
| Chronic mitral disease | 9 | 4 |
| Chronic aortic disease | 6 | 4 |
| Sclerosis of coronaries | 6 | 1 |
| Sclerosis of tricuspid | 3 | .. |
| Hydropericardium | 3 | .. |
| Pericardial ecchymosis | 1 | .. |
| Chronic pericarditis | 1 | .. |
| Acute pericarditis | 2 | .. |
| Chronic myocarditis | 6 | .. |
| Epicardial plaques | 4 | 8 |
| Chronic endocarditis | 3 | 1 |
| Fatty heart | 1 | 1 |
| Atrophy of heart | 1 | 5 |
| Atheroma of aorta | 2 | .. |
| Cloudy swelling | .. | 2 |
| Subendocardial hæmorrhage | .. | 1 |
| Lipomatosis pericardii | .. | 1 |
| Acute endocarditis | 1 | 1 |
| Total lesions | 61 | 32 |

[1] Miliary tuberculosis, gall-stones, cancer of breast, cancer of rectum, gastric ulcer, cerebral tumor, tuberculous meningitis, ovarian cyst, pulmonary tuberculosis, cancer of liver, syphilis, uræmia, pneumonia, pyosalpinx, multiple neuritis, gangrene of lung.

## BIBLIOGRAPHY


1. BARROWS. Am. J. Surg., 1912, xxvi, 161.
2. NEU. Gynäk. Rundschau, 1911, No. 20, 778.
3. McGLINN. N. Y. M. J., 1911, June 3.
4. McDONALD. J. Am. M. Ass., 1909, p. 93.
5. JASCHKE. Zentralbl. f. d. Grenzgeb. d. Med. u. Chir., 1912, May 28.
6. NEU and WOLFE. München. med. Wchnschr., 1912, Jan. 9.
7. KELLY and NOBLE. Gynecology and Abdominal Surgery, Vol. 1, p. 671.
8. KELLY and CULLEN. Myomata of the Uterus, p. 671.
9. BRICKNER. Am. J. Obst., N. Y., 1910, Dec.
10. ROSTHORN. Twenty-fifth Congress of Internal Medicine.
11. WINTER. Ztschr. f. Geburtsh. u. Gynäk., 1905, lv.
12. SHOEMAKER. Am. Med., 1904, viii.
13. BALDY. Am. J. Obst., N. Y., lii, 370.
14. WILLIAMS. Brit. M. J., i, 105.
15. DOANE. Surg., Gynec. & Obst., 1912, xiv, 42.
16. FLECK. Arch. f. Gynäk., lxxi.
17. DORAN. J. Obst. & Gynec. Brit. Emp., iii.
18. CUMSTON. N. Y. M. J., 1905, Oct. 28.
19. SEBILEAU. Rev. de Chir., 1888.
20. BOLDT. N. Y. M. J., 1905, lxxxi, 887.


## ADDITIONAL BIBLIOGRAPHY


YOUNG and WILLIAMS: Boston M. & S. J., 1910, clxii, 663.
BERKELEY: Clin. J., Lond., 1911, xxxviii, 70.
PAYNE: J. Am. M. Ass., 1911, May 6, p. 1324.
WILLIAMS: Edinb. M. J., xxxvi, 40.
FENWICK: Lancet, Lond., 1888, May 26 and June 2.
WILSON: Lancet, Lond., 1900, May 12.
SMITH: Lancet, Lond., 1900, May 12.
WEBSTER: Am. Med., 1905, March 11.
SAMUELS: N. Y. M. J., 1910, May 28.
CULLEN: Bull. Johns Hopkins Hosp.
KISCH: Leipzig, G. Thieme, 1898.
WEST: Post-Graduate, 1910.
WILLMOTH: Lancet-Clin., 1908, xcix, 101.
TRACEY: Surg., Gynec. & Obst., 1908, vi, 246.
CAMERON: Glasgow M. J., 1908, lxx,177.
ANDERSON: Yale M. J., 1908–09, xv, 173.
LURGIN: Russk. Vrach, 1905, lxxv.
BERTHOLD: Zentralbl. f. Gynäk., xvii, 174.
HENNIG: Ztschr. f. Geburtsh. u. Gynäk., Stuttg., xxix, 131.
STRASSMAN and LEHMAN: Arch. f. Gynäk., lvi, 503.
MEYER: Ztschr. f. Geburtsh. u. Gynäk., xxvii and xxix.
WYDER: Samml. klin. Vort., No. 146.
WETTERGREEN: Zentralbl. f. Gynäk., 1890, p. 189.
LEOPOLD and EHRENFREUND. Wien, 1903.
DEHIO. Deutsch Arch. f. klin. Med., lxii, 1.
KELLE: Klin. z. Leips., 1893.
BROSMIN: Zentralbl. f. Gynäk., 1894, p. 96.
LEOPOLD: Zentralbl. f. Gynäk., 1894, p. 5.
FEHLING: Zentralbl. f. Gynäk., xi, p. 7.
HOFMEIER: Ztschr. f. Geburtsh. u. Gynäk., 1885, p. 371.
SAENGER: Zentralbl. f. Gynäk., 1884, p. 589.
ROSE: Deutsche Ztschr. f. Chir., xxv.
DOHRN: Ztschr. f. Geburtsh. u. Gynäk., xi, 136.
LANDAU: Zentralbl. f. Gynäk., 1889, p. 171.
ROUTH: Lancet, Lond., 1900, May 12.
FREUND: Deutsche Ztschr. f. Chir., 1890.
CHAVANNEZ: Rev. mens. de gynéc. (etc.), Bordeaux, 1900 March.
WILLIAMS: Uterine Tumors, 1901.
EDEBOHLS: Am. J. Obst., N. Y., 1893.
NELATON: Semaine méd., 1897.
VOSKRESSENSKY: Semaine méd., 1899.
NEATLY: Homœp. J. Obst., N. Y., 1903, xxv, 341.
STURMDORFF: Med. News, 1905, lxxxvi, 262.
HALL: Am. J. Obst., N. Y., 1913, Jan.
VON LINGEN: Ztschr. f. Geburtsh. u. Gynäk., lvi, 3.

# A STUDY OF THE COMPARATIVE VALUE OF FUNCTIONAL TESTS IN THE SURGICAL DISEASES OF THE KIDNEY SECONDARY TO OBSTRUCTION IN THE LOWER URINARY TRACT

By L. G. ROWNTREE, M. D., J. T. GERAGHTY, M. D., and E. K. MARSHALL, Jr., M. D.,[1] Baltimore, Maryland

In our previous communications[2] on the subject of renal function attention has been called to the value of phthalein in affording an index to the renal functional capacity in the changes resulting from obstruction in the lower urinary tract. It was pointed out that such patients are frequently the subject of hydronephrosis, pyelonephritis, pyonephrosis, pressure atrophy, and resulting changes in functional activity, and that the urine output, urea, and total solids might be practically normal and yet the patient be on the verge of renal failure which would surely be precipitated by any radical surgical interference. The phthalein was shown to be of value in all these cases and to allow of differentiation between those cases with severe renal damage and those in which the renal involvement was slight. It was further shown that the marked improvement of the renal condition and operative risk which followed the adoption of Young's preliminary treatment (constant catheter and forcing of water) was the result to a large extent of the improvement of the renal functional capacity. It was claimed that the test made it possible to determine the cases suitable or unsuitable for operation and also to determine in any given case the most propitious time for surgical intervention.

In this study a number of tests have been utilized in order to determine if any individual test or any combination of tests furnishes information other than that derived from the use of phthalein. The number of functional tests has increased to such an extent that it is essential to determine which can be discarded without loss. Only through familiarity with the reliability, value, limitations, peculiarities, and the significance of the findings of each test in the various types of disease is the most profitable selection of tests made possible.

Renal functional capacity is usually ascertained in one of two ways: (1) Tests of excretory capacity through the quantitative determinations of the secretion of various substances in the urine,— dyes, methylene blue, indigo-carmin, rosaniline, and phthalein; other chemicals, potassium iodide, lactose, salicylates, sodium chloride, urea, sugar following phloridzin, and the enzyme, diastase. (2) Tests of retention through the determination of the concentration of certain substances in the blood, ions — through electrical conductivity, molecules and ions — through cryoscopy, and urea, total incoagulable nitrogen and cholesterin. Choice has been made of what has appeared to be the most important representatives of these groups; viz., of the first, phthalein, lactose, diastase, and urea; of the second, cryoscopy and blood urea.

## THE TESTS EMPLOYED AND THEIR TECHNIQUE

1. The *phthalein* was used according to the usual technique.

2. *Lactose* was employed according to Schlayer's technique:[3] 2.5 gms. of lactose are dissolved in 25 ccm. of freshly distilled water, placed in a 50 ccm. Erlenmeyer flask stoppered with cotton. This is pasteurized for 4 hours on four successive days between 75°–80° C., and is injected intravenously, the number of hours necessary for excretion being determined. Nylander's and Fehling's tests were used to demonstrate the presence or absence of sugar. No quantitative polarimetric determinations which are advised by Schlayer were utilized, since only in a small proportion of cases did glycosuria occur.

3. *Diastase.* Diastase was introduced into functional renal work by Wohlgemuth[4] for

[2] Rowntree and Geraghty: J. Phar. & Exp. Therap., 1910, i, 579; Arch. Internal Med., 1912, ix, 284.

[3] Schlayer and Takayasu: Deutsche Arch. f. klin. Med.

[4] Wohlgemuth: Ztschr. f. Urol., 1911, v, 801.

[1] From the Pharmacological and Physiological Chemical Laboratories of the Johns Hopkins University and the Genito-Urinary Clinic of the Johns Hopkins Hospital.

determining the relative functional capacity of the two kidneys. A modification of this method was devised by us to make the test adaptable for determining total renal functional capacity. The technique which we employed was elaborated in conjunction with Dr. Thomas R. Brown,[1] who has demonstrated with it that the total daily output in urine is fairly constant. The technique employed was as follows: One-fifth of the twenty-four hour urine collected under toluol was neutralized and diluted to 1 L. By means of a graduated 2 ccm. pipette, decreasing amounts of urine were placed in a series of twelve tubes (arranged in a rack) as follows: 1.8, 1.6, 1.4, 1.2, 1, 0.8, 0.6, 0.4 ccm. Ten ccm. of the diluted urine was further diluted to 20 ccm. and of this decreasing amounts placed in the remaining tubes of the series as follows: 0.4, 0.2, 0.1, 0.05 ccm. To each tube was added sufficient 1 per cent NaCl solution to bring the total volume in each tube to 2 ccm. Two ccm. of a 0.1 per cent freshly prepared soluble starch solution was added to each tube. The rack with the tubes was placed in a water-bath at 38° C. for a half-hour, then transferred to cold water for 3 minutes. Sufficient 1/50 N iodine solution was added drop by drop in amounts sufficient to elicit a permanent color. The occurrence of blue or violet shows incomplete digestion, while the last tube without the violet color indicates the diastatic activity of the urine and from it is calculated. The diastatic activity is expressed by $d\frac{30'}{30}$ which represents the number of ccm. of 0.1 per cent starch solution capable of being digested at 38° C. in 30 minutes by 1 ccm. of the urine as originally diluted.

The *urea* content of the twenty-four hour specimens of urine was determined by the Doremus and the Marshall[2] methods, the results of each being given.

The principle of Marshall's method consists in the conversion of the urea into ammonium carbonate by means of an enzyme, urease, present in an extract of the soy bean, and the titration with standard hydrochloric acid and methyl orange. "Two 5 ccm. portions of urine are measured into flasks of 200–300 ccm. capacity and diluted with distilled water to about 100–125 ccm. Two ccm. of the enzyme solution are added to one flask, a few drops of toluol to each and the solutions allowed to remain, well stoppered, at room temperature over night. The fluid in each flask is titrated with 0.1 NHCl and methyl orange. The amount of hydrochloric acid required for neutralization of the contents of the flask containing the urine and enzyme solution less the amount required for neutralization of 5 ccm. urine alone and 2 ccm. enzyme solution alone corresponds to the urea originally present in the urine. This value multiplied by 0.6 gives the number of grams of urea per liter of urine.

The freezing point of serum was made in the ordinary way, utilizing the Beckmann apparatus, 25 to 50 ccm. of blood usually being taken from the patient.

The blood urea was determined according to Marshall's method[3] which is as follows: Two equal portions of the serum (3 ccm. or 5 ccm.) are measured into two small test tubes, 1 ccm. of the enzyme solution added to one, toluol to each, and the tubes allowed to remain over night. The contents of each tube are washed into tall cylinders, alcohol and sodium carbonate added, and the ammonia removed by means of a strong air current. The ammonia is collected in flasks containing 25 ccm. N/50 hydrochloric acid. When all the ammonia has been driven over, the excess of acid in the flasks is titrated with N/50 sodium hydroxide and sodium alizarin sulphonate. The amount of hydrochloric acid required to neutralize the ammonia from the serum and enzyme solution less the amount required for the ammonia from the serum alone represents the urea present in the amount of serum taken.

### THE RESULTS OBTAINED

In the following table are presented data relating to 43 cases, in the majority of which a combination of all of the tests mentioned has been utilized. The cases for the most part exhibited varying degrees of urinary obstruction.

Our earlier views in regard to the value of the phthalein test in this type of case require

[1] To appear shortly.

[2] Marshall: J. Biol. Chem., 1913, xiv, 283.

[3] To appear in an early number of Journal Biological Chemistry.

| | Surg. No. Case | Name | Date admitted | Diagnosis | B. P. | Date | Phthalein Appear Minutes | Phthalein 1st Hr. | Phthalein 2d Hr. | Diastase $d\frac{38°}{30'}$ | 24 Hour Amount ccm. | Urine Urea grams | Cryoscopy | Lactose | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 30731 | M. L. B.<br>60 years | 11/12/12 | Enlarged prostate<br>Cystitis | | | 17 | 9% | 13% | 5.0 | 3100 | | | Negative | Prostatectomy.<br>Good recovery. |
| 2 | 30765 | W. H. A.<br>70 years | 11/12/12 | Hypertrophy prostate | | | 15 | 17% | 20% | | | | | Negative | Prostatectomy.<br>Recovery. |
| 3 | 30901 | Dr. J. K.<br>63 years | 11/16/12 | Hypertrophy prostate | 185 | 11/4/12 | 7 | 22% | 5% | | | | | Negative | Prostatectomy.<br>Recovery. |
| 4 | 30919 | J. S. J.<br>59 years | 11/19/12<br>1/2/13 | Hypertrophy prostate<br>Chr. nephritis | 220 | 11/16/12<br>1/1/13<br>1/21/13<br>1/23/13 | 14<br>62?<br>14<br>15 | 6%<br>10%<br>21%<br>17% | 8%<br>20%<br>20%<br>30% | | | | .62 1/2/13 | Negative<br>1/2/13 | Prostatectomy.<br>Recovery. |
| 5 | 30928 | Wm. W.<br>69 years | 11/19/12<br>11/30/12 | Enlarged prostate<br>Pyelonephritis | 204 | 11/17/12<br>11/30/12 | 30<br>20 | trace<br>15% | 5%<br>10% | 11/21/12<br>10.0 | 2900 | | .59 11/21/12 | Negative<br>11/20/12 | Prostatectomy.<br>Died hæmorrhage. |
| 6 | 30918 | Wm. C.<br>55 years | 11/16/12<br>11/24/12 | Tabes<br>200 ccm.<br>resid. urine | 188 | 11/16/12<br>11/24/12 | 11<br>15 | 45%<br>48% | 11%<br>12% | 2.5 | 1400 | | | Negative<br>11/20/12 | No operation. |
| 7 | 30932 | G. F.<br>17 years | 11/18/12<br>11/24/12<br>1/27/13<br>2/7/13 | Double hydronephrosis<br>Congenital valves<br>Prostatic urethra | | 11/18/12 | ?<br>?<br>?<br>? | trace<br>trace<br>trace<br>trace | 5%<br>trace<br>3%<br>3% | 11/22/12<br>2.0<br>2/7/13<br>0 | 3340<br><br>2050 | 5.0<br><br>14.0 | .61 11/20/12<br>.63 1/27/13<br>.66 2/7/13 | Negative<br>11/20/12 | Several diastase estimations of urine between 2/6–12/13 all same. Blood urea, 1.332 gms. per liter.<br>Died pneumonia. |
| 8 | 30962 | C. W.<br>64 years | 11/21/12<br><br>12/7/12 | Hypertrophy prostate<br><br>Operation | Put | 11/21/12<br>11/24/12<br>on forced | 22<br>13<br>water. | 32%<br>25%<br>Toxic | 16%<br>35% | | | | .55 11/22/12<br>.48 12/7/12<br>.54 12/12/12 | 4 hrs.[1] | Prostatectomy.<br>Recovery. |
| 9 | 30990 | C. R.<br>80 years | 11/26/12<br>12/9/12<br>1/1/13<br>3/18/13 | Hypertrophy prostate<br>Cystitis<br>Pyelonephritis, Very weak<br>Condition bad | 170 | 11/27/12<br>12/9/12<br>1/1/13 | 22<br>64?<br>27 | trace<br>5%<br>17% | 5%<br>6%<br>15% | 2.0<br><br>1.7 | 2980<br>3/11/13<br>1580 | 20.8<br><br>18.1<br>*15.3* | .57 1/2/13 | | Prostatectomy.<br>Recovery. |
| 10 | 30997 | J. C.<br>62 years | | Hypertrophy prostate | 165 | 11/27/13 | 18 | 42% | 20% | | | | | Negative<br>11/27/12 | Prostatectomy.<br>Recovery. |
| 11 | 31028 | F. E.<br>58 years | 12/3/12<br>12/9/12 | Hypertrophy prostate<br>Arteriosclerosis | 225 | 12/3/12 | 12 | 30% | 20% | 12/7/12<br>5.0 | 3400<br>12/6/12 | 10.2 | .57 12/5/12 | Negative<br>12/5/12 | Prostatectomy.<br>Recovery. |
| 12 | 31027 | J. B.<br>34 years | 12/3/12 | Nephroptosis, left | 144 | 12/3/12 | 5½ | 48% | 17% | | | | .58 12/5/12 | Negative<br>12/5/12 | Suspension.<br>Recovery. |
| 13 | 31029 | S. B.<br>77 years | 12/3/12 | Hypertrophy prostate<br>Arteriosclerosis | 220 | 12/3/12 | 12 | 28% | 10% | 12/4/12<br>2.5 | 2300<br>12/3/12 | 15.8 | .51 12/7/12 | Negative<br>12/5/12 | Prostatectomy.<br>Died broncho-pneumonia. |
| 14 | 31039 | M. E. C.<br>57 years | 12/4/12 | Hypertrophy prostate | | 12/4/12 | 15 | 17% | 14% | | | | .53 12/5/12 | | Prostatectomy.<br>Recovery. |
| 15 | 31059 | Jos. P.<br>75 years | 12/6/12 | Hypertrophy prostate<br>Ves. calculi<br>Suprapubic drainage | | 12/7/12<br>1/1/13<br>1/21/13 | 32<br>62<br>14 | 7%<br>10%<br>24% | 12%<br>20%<br>20% | 12/13/12<br>2.5 | 3220<br>12/12/12 | | .60 12/12/12<br>.71 1/2/13<br>.59 1/23/13 | Negative<br>1/23/13 | Prostatectomy, 1/23/12.<br>Died suddenly after going home. |
| 16 | 31164 | N. C.<br>75 years | 12/23/12 | Cancer bladder with partial retention. | | 12/23/12 | 7 | 22% | 15% | | | . | .51 12/23/12 | | No operation. |
| 17 | 31214 | E. J.<br>60 years | 1/1/13<br><br>1/7/13 | Arteriosclerosis, no retention of urine<br>Chr. nephritis | 200 | 1/1/13 | 13 | 10% | 9% | 1/8/13<br>5.0 | 1625<br>1/7/13<br>2200<br>1/2/13<br>2760<br>1/3/13 | 17.9 | .59<br>.56 | Negative<br>1/23/13 | No operation. |

[1] Not quantitative test. 11/22/12.

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 18 | 31225 | D. M. D.<br>65 years | 1/2/13<br>1/8/13 | Double polycystic kidneys | high | 1/1/13 | 20 | trace | trace | 1/8/13<br>3.3 | 2650 | 18.5 | .70 | 1/2/13 | | Died suddenly a few weeks later. No autopsy. |
| 19 | 31249 | J. S.<br>53 years | 1/4/13 | Hypertrophy prostate | | 1/4/13 | 9 | 34% | 14% | | | | .56 | 1/9/13 | | Prostatectomy.<br>Recovery. |
| 20 | 31313 | L. F.<br>72 years | 1/15/13 | Hypertrophy prostate<br>Bad heart condition | | 1/15/13<br>1/21/13 | 16<br>10 | 17%<br>17% | 14%<br>15% | | | | .56 | 1/16/13 | | Prostatectomy.<br>Recovery. |
| 21 | 29252 | L. R.<br>45 years | 1/18/13 | Bilateral pyonephrosis<br>Condition bad | | 1/18/13 | 35 | trace | trace | | | | .61 | 1/20/13 | | No operation. |
| 22 | 31399 | J. T. C.<br>74 years | 2/2/13 | Hypertrophy prostate | | 2/2/13 | 23 | 7% | 1% | | | | .58 | 2/1/13 | | Prostatectomy.<br>Recovery. |
| 23 | 31573 | S. B. R.<br>42 years | 2/22/13 | Contracture vesical neck | | 2/22/13 | 10 | 45% | 13% | | 3/10/13<br>1580 | *15.3* | .54 | 2/24/13 | | Punch.<br>Recovery. |
| 24 | 31553 | Col. F. M.<br>72 years | 2/20/13 | Cancer prostate<br>Paralysis, Myocarditis | | 2/20/13<br>3/6/13 | 13<br>12 | 30%<br>41% | 19%<br>17% | 2/28/13<br>2.5 | 1560<br>2/27/13 | 11.7<br>*10.4* | .54 | 2/26/13 | | Prostatectomy, 3/7/13.<br>Recovery. |
| 25 | 31592 | Wm. L.<br>63 years | 2/25/13 | Hypertrophy prostate | | | | | | 10.0 | 2380 | 19.0<br>*15.8* | .54 | 2/26/13 | | Prostatectomy, 2/28/13.<br>Recovery. |
| 26 | 31546 | Gen. J. S.<br>71 years | 2/19/13 | Chr. cystitis<br>Contracted bladder | 140 | 2/23/13<br>3/6/13 | 6<br>10 | 20%<br>26% | 15%<br>15% | 2/28/13<br>3.3 | 1220<br>2/27/13 | 19.5<br>*15.9* | | | | No operation. |
| 27 | 31593 | L. V. M.<br>69 years | 2/26 13 | Hypertrophy prostate<br>Acute double pyelone-phritis | | 3/3/13 | 10 | 22% | 19% | 3/5/13<br>3.3 | 830<br>3/2/13 | 9.5<br>*8.7* | .60 | 3/1/13 | | Prostatectomy, 3/5/13.<br>Blood urea, 0.660 gms. per liter. Died. |
| 28 | 31620 | Col. C. W.<br>75 years | 3/1/13 | Hypertrophy prostate | | 3/2/13<br>3/4/13<br>3/6/13 | 10<br>11<br>10 | 22%<br>30%<br>38% | 17%<br>18%<br>28% | 3/5/13<br>2.5 | 5080<br>3/5/13 | 44.8<br>*26.4* | .50 | 3/4/13 | | Prostatectomy, 3/7/13.<br>Recovery. |
| 29 | 31619 | Dr. A. H. L.<br>72 years | 3/1/13 | Cancer prostate | | 3/3/13 | 13 | 27% | 10% | | | | .55 | 3/4/13 | | Prostatectomy, 3/5/13.<br>Blood urea, .426 gms. per liter.<br>Recovery. |
| 30 | 31657 | E. C. B.<br>69 years | 3/1/13 | Hypertrophy prostate<br>Suprapubic for drainage<br>3/14/13 | 140 | 3/5/13<br>3/8/13<br>3/10/13 | 41<br>35<br>35 | 3%<br>14%<br>17% | 10%<br>15% | 3/11/13<br>1.3<br>3/18/13<br>2.0 | 4585<br>3/11/13<br>5480<br>3/18/13<br>5025<br>3/19/13 | *21.9*<br>35.6<br>*30.2* | .54 | 3/10/13 | | |
| 31 | 31670 | G. N.<br>66 years | 3/7/13 | Cancer prostate | 140 | 3/8/13 | 14 | 48% | 17% | 3/12/13<br>3.3 | 1555<br>3/12/13 | 13.9<br>*11.9* | .61 | 3/11/13 | | Prostatectomy operation.<br>Blood urea, .470 gms. per liter.<br>Recovery. |
| 32 | 31705 | R. F.<br>71 years | 3/12/13 | Cancer prostate | | 3/9/13 | 11 | 33% | 27% | 3/19/13<br>2.5 | 2320<br>3/19/13 | 23.3 | .60 | 3/19/13 | | Prostatectomy, 4/2/13.<br>Blood urea, .222 gms. per liter.<br>Recovery. |
| 33 | 31782 | W. H. D.<br>48 years | 3/24/13 | Hæmaturia | | 3/22/13<br>3/25/13<br>3/26/13 | 10<br>10<br>2½ | 38%<br>43%<br>1st. 15 min. | 12%<br>R.15<br>L.18 | 1.7 | 1830<br>3/24/13 | 6.4<br>*11.9* | .59 | 3/25/13 | Negative<br>3/25/13 | No operation.<br>Blood urea, .230 gms. per liter. |
| 34 | 31824 | C. K.<br>65 years | 3/28/13 | Hypertrophy prostate | | 3/30/13 | 19 | trace | trace | 4.8<br>3.3 | 1575<br>4/9/13 | 9.5<br>*4.4* | .61<br>.59 | 4/8/13 | Negative<br>4/9/13 | Prostatectomy. |
| 35 | 29319 | J. T. | 2/23/12 | Cancer prostate | 155 | 2/26/12 | 9 | 15% | 18% | | | | | | 8 hours | |
| 36 | 31779 | G. H.<br>35 years | 3/21/13 | Double polycystic kidney | 150 | 3/28/13 | 10 | 20% | 16% | 1.7 | 1260<br>4/2/13<br>800<br>4/9/13 | 12.6<br>4.4 | | | | Went home. |

| | Surg. No. Case | Name | Date admitted | Diagnosis | B. P. | Date | Phthalein | | | | Diastase d 38° 30′ | 24 Hour Amount cc. | Urine Urea grams | Cryoscopy | | Lactose | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Appear minutes | 1st Hr. | 2d Hr. | | | | | | | | |
| 37 | 31890 | A. H. 53 years | 4/6/13 | Hypertrophy prostate | | 4/8/13<br>4/20/13 | 33<br>14 | 16% | 11% | | 3.3 | 1860<br>4/22/13 | 15.4 | .61 | 4/9/13 | 4/9/13* | Blood urea, .350 gms. per liter.<br>4/9/13. |
| 38 | 31878 | J. F. N. 59 years | 4/4/13 | Hypertrophy of prostate | 115 | 4/10/13 | 10 | trace | 7% | | | | | .52 | 4/19/13 | | Blood urea, 2.17 gms. per liter.<br>4/19/13.<br>Sent home. |
| 39 | | B. | 5/15/13 | Bilateral pyelonephritis | | | 12 | 12% | 18% | | | 4000 | 4.0 | | | Negative | Iodid 48 hours. |
| 40 | 32020 | J. F. 61 years | 4/23/13 | Hypertrophy prostate | | 4/21/13<br>4/27/13 | 20<br>12 | 11%<br>25% | | | 5.0 | 4335<br>4/29/13 | 15.2<br>13.0 | .50 | 4/29/13 | 1st hr. pos<br>9th & 10th pos. | Prostatectomy, 5/2/13.<br>Blood urea, .198 gms. per liter.<br>Recovery. |
| 41 | 32048 | L. D. 70 years | 4/28/13 | Carcinoma prostate<br>Vesical calculus | | 4/29/13<br>5/2/13 | 16<br>10 | 23%<br>40% | 10%<br>14% | | | | | .57 | | 1st & 2d hrs. pos.<br>5th & 6th pos. | Prostatectomy, 5/2/13.<br>Blood urea, .450 gms. per liter.<br>Recovery. |
| 42 | 31908 | J. L. 53 years | 4/21/13 | Carcinoma prostate<br>Resid. urine, 450 cc. | 170 | 4/21/13<br>4/27/13 | 55<br>16 | 12%<br>34% | 5%<br>8% | | 5.0 | 2040<br>4/30/13 | 19.88 | .54 | 4/29/13 | 1st 4 hrs. pos. | Prostatectomy, 5/2/13.<br>Recovery.<br>Blood urea, .350 gms. per liter. |
| 43 | Not indexed | H. 55 years | 6/1/13 | Vesical calculi stricture | | 5/22/13<br>5/28/13 | | trace<br>trace | trace<br>trace | | | | | .60<br>.66 | | | Blood urea, 1.50 gms. per liter.<br>2.64 gms. per liter.<br>Dead. |

Urea in urine indicated by *italics* was determined by Marshall's method.
* First hour negative; second hour positive; third and fourth hours positive; other eight negative.

no revision. As an index of the total renal function it has proven uniformly accurate and reliable.

The lactose test has been employed in 22 cases. In all of the earlier cases the urine was collected for 4 hours and each 2 hours thereafter up to 12 hours following Schlayer's technique. In only two cases, Nos. 8 and 35, was a positive test for sugar obtained. In No. 6, a case of tabes, with 200 ccm. residual urine, the phthalein showed practically a normal renal function, while clinical findings showed no evidence of renal disease. However, no lactose was obtained in this case. In Case 10, with hypertrophied prostate and normal renal function as indicated by phthalein, no lactose was excreted. This patient was in good clinical condition, and successful prostatectomy was performed. In four later cases in which following the lactose injection the urine was collected at hourly intervals, a trace of lactose was obtained in some of the periods. The renal function in these cases was more impaired than in many of the earlier ones in which the first collection was for 4 hours. It is not improbable that if the urine had been collected at hourly intervals in these earlier cases, a positive test might have been obtained in some of the hourly specimens in many of the cases which showed a negative finding with the technique employed. In two of the four cases mentioned above the excretion was complete within 4 hours. One of these, however, had a severe grade of renal involvement.

The majority of the patients in this group were on forced water and excreted large quantities of urine. Marked dilution resulting from this polyuria may help to explain the failure to detect lactose where traces only were excreted. The failure on the part of lactose to appear in the urine is in keeping with our earlier experiences with phloridzin in this type of renal disease. Phloridzin was used in eight patients suffering from renal changes secondary to prostate hypertrophy but in not a single instance was sugar recovered. Further observations were therefore not made.

The lactose test in this type of case has proven of but little value from a diagnostic

standpoint, and of no value in relation to prognosis.

Twenty-seven diastase estimations were made in 24 cases. We have considered the normal diastatic activity of the diluted urine as $d\,\frac{38°}{30'} = 5.0$.

In some cases with severe renal damage, the diastase content was normal. A striking example of this is Case 5, in which the phthalein and the clinical condition indicated severe renal impairment. The diastase value was $d\,\frac{38°}{30'} = 10$. This patient died of hæmorrhage following prostatectomy, and at autopsy a well marked chronic diffuse nephritis with chronic bilateral pyelonephritis and a moderate grade of hydronephrosis was discovered. One kidney was one-fourth the size of the other, the larger kidney weighing 170 grams. The character of the lesions was similar in both kidneys. On the other hand, in another case, Case 18, in slight hæmaturia with advanced double polycystic disease of the kidneys, with a blood pressure of over 200 mm., a trace of phthalein in two hours, and a freezing point of $-.70°$, the diastase was only slightly reduced being $d\,\frac{38°}{30'} = 3.3$. This patient died a few weeks after leaving the hospital, without the cause of death being ascertained.

In Case 33 in which the phthalein and clinical findings showed only slight renal impairment, the diastase was markedly decreased, $d\,\frac{38°}{30'} = 1.7$.

In the majority of instances of disease a decreased diastatic activity is present, but no constant or definite relationship between the diastatic activity and the true renal function as shown by phthalein and clinical findings exists. Where, however, a complete absence of diastase in the urine occurs, it apparently indicates a bad prognosis. Two cases, Nos. 7 and 43, with severe renal impairment as shown by excretory tests and the presence of marked cumulative phenomena, showed no diastase, and death occurred within two weeks in Case 43 and within one month in the other. Autopsies were obtained in each of these cases and revealed advanced renal disease.

Urea estimations of the twenty-four hour output were made in twenty-two cases. These give information of but little value. Patients with very low renal function and advanced disease frequently excrete larger amounts than those in good clinical condition and with comparatively good renal function. When, however, there is a persistently very low urea elimination, it indicates a severe grade of renal disturbance.

In utilizing the second group of tests, viz., tests of retention, a consideration of what is to be accepted as the normal limit seems advisable. Although Folin and Denis [1] accept 0.28 gm. urea per liter as the normal, where no dietary control is exercised in health or in many diseases without recognizable renal changes much higher values are encountered. From our observations it seems advisable to place the limit of normal at 0.55 for urea, and 0.50 gms. per L. total incoagulable N and $-.60$ for the freezing point. Evidences of retention greater than this are referred to as cumulative phenomena.

Cryoscopy has been employed in 34 cases, 43 determinations having being made. Variations from $-0.48$ to $-0.71$ were encountered. In every instance except one a normal phthalein has been associated with a normal freezing point. In this case, No. 31, $\delta$ was $-0.61$ with a phthalein practically normal, 48 per cent for 1 hour. The urea was close to the higher limit of normal, 0.47 gm. per liter.

The highest $\delta$ ($-0.48$) occurred in a man who was being continuously forced to drink large quantities of water.

Nine cases showed cumulative phenomena in that they had a $\delta$ lower than $-0.60$. Except in the case, No. 31, already mentioned, renal function was seriously involved in each instance, as indicated by phthalein and the general clinical condition.

A decrease in phthalein output of serious import may be associated with a normal $\delta$. In a group of 4 cases, Nos. 5, 22, 38, and 43, a trace or less than 10 per cent phthalein was excreted in 2 hours, but the freezing points were normal. These cases were all seriously ill clinically and in the only two cases, 38 and 43, in which blood urea was determined, it was found to be abnormally high, 2.17 and 1.50

[1] Folin and Denis: J. Biol. Chem., 1913, xiv, 29.

gms. per L. respectively. Repetition of tests 5 days later showed in Case 43 a $\delta$ −0.66 and a urea 2.64 gm. per L. This patient died in uræmia, while in the other case operation was refused and the patient sent home on account of his poor general condition.

Blood urea was determined in 12 cases. In every instance in which the phthalein was high the blood urea was normal. Abnormally high urea content was encountered in four instances only, Cases 7, 27, 38, and 43, in all of which the phthalein was low. In Cases 38 and 43, urea was a better index to the renal condition than the cryoscopy, which, as has been pointed out, gave normal values. It would therefore appear that the urea may afford indications of cumulative phenomena earlier than the cryoscopy.

In no instance was a normal blood urea associated with markedly decreased phthalein. Case 37, however, with 27 per cent phthalein for 2 hours showed 0.35 gms. urea per L., while the $\delta$ was −0.61.

From a consideration of these data it appears that our previous claims in relation to the value of phthalein were well founded. The phthalein undoubtedly affords the truest index of the functional capacity of the kidney in this group of cases. In no instance was its findings incompatible with the clinical condition and subsequent history. Corroborative evidence only was adduced from the employment of the other tests, particularly valuable in this connection being the presence of cumulative phenomena. In several instances, however, the tests of retention failed to indicate the serious nature of the renal change, so that the findings of these tests can only be considered of great value when marked retention is indicated. The almost constant suppression of lactose in these cases, although rendering the test useless, is an interesting phenomena. From the standpoint of explanation, this is worthy of investigation. Urinary diastase and urea are of about equal value and are unreliable indices to renal functional capacity generally, but where very low values are persistently indicated they have some prognostic significance.

Cumulative phenomena do not occur in the presence of good renal functional capacity, and consequently the tests are unnecessary where the phthalein is normal. They do not occur constantly or early in presence of even marked renal involvement, and consequently would prove misleading in a certain proportion of cases with phthalein not employed. Positive cumulative phenomena, however, are of the greatest prognostic significance.

## CONCLUSIONS

To detect the functional impairment associated with the renal changes consequent upon obstruction in the lower urinary tract, the phthalein affords an indispensable index to the true renal condition. Nothing beyond corroborative evidence is to be obtained from the employment of other functional tests.

# THE INTERCAROTID PARAGANGLION AND ITS TUMORS

By DONALD C. BALFOUR, M. D., and FRANZ WILDNER, M. D., Rochester, Minnesota
Mayo Clinic.

## SURGERY

By Donald C. Balfour, M. D.

TUMORS of the intercarotid paraganglion have, as a rule, been found malignant and recurrences following their removal are frequent. Whether this be due to the fact that the tumors are seldom operated on in an early stage or because of a high degree of primary malignancy is not clear. In the cases heretofore reported the tumors have varied considerably in size and frequently have been designated as perithelioma in type. The diagnosis is rarely, if ever, made before operation and usually not until pathologic examination reveals the histologic picture.

The removal of a tumor of this gland, because of its situation and malignancy, often entails somewhat drastic measures. Its position in the carotid notch in certain cases necessitates ligation of one or all of the main arterial trunks. In the case reported herewith removal of 4 cm. of the internal jugular vein was necessary.

The patient operated on in the Mayo Clinic was a woman 34 years of age who came for examination because of the distress incident to a large degenerating adenoma of the thyroid. The history of the patient was not suggestive except in regard to the gradually increasing pressure and severe pain radiating through the right shoulder and down the right arm. The physical examination revealed an enlargement of the thyroid 5 x 6½ inches, marked evidences of obstruction in the deviated trachea, and dysphonia. Laryngoscopic examination demonstrated a paralysis of the right vocal cord. Otherwise the physical findings were inconsequential.

On April 5, 1913, under light ether anæsthesia, the right lobe of the thyroid, which contained the degenerating adenoma, was removed. After completing the removal of the gland and ligating the vessels, further investigation revealed a separate mass in the right submaxillary region about the size of a lemon, having the appearance of a degenerating fœtal adenoma. At first this was believed to be an aberrant thyroid, but on attempting its removal it was discovered to be of an entirely different character, suggesting the probability of some malignant condition. The tumor was firmly adherent to all the surrounding structures and apparently had been crowded up into the submaxillary triangle by the enlarged thyroid. After freeing it in front and below it was found on deep dissection to be intimately connected with the deep vessels. The mass was dissected from the carotid vessels, but it had invaded the internal jugular vein and it was necessary to remove about 4 inches of this structure. This invasion of the vein made certain the malignancy of the tumor, and although the growth was removed *en masse* it seemed probable that more or less rapid recurrence would take place.[1] The field of operation was swabbed with Harrington's solution and a 24-hour pack of the same used to inhibit implantation of malignant cells. The patient's convalescence in the hospital was uninterrupted; she left on the sixth day. During her stay in town she suddenly developed a hemiplegia, which persisted until she left for her home. A recent report indicates the persistence of the hemiplegia and a probable local recurrence.

The after-history of patients in whom tumor of the intercarotid paraganglion has been removed is not encouraging. A cure without permanent disability is rare. Keen (1), who first called the attention of the American profession to the condition, states that only 7 patients of the 27 cases collected by him (including one of his own) recovered without complications. Ordinarily, if the patient does not succumb to recurrence, some disability which is usually due to brain-lesion occurs.

## ANATOMY, PHYSIOLOGY, AND PATHOLOGY

By Franz Wildner, M. D.

*Anatomy.* In 1743 Albrecht von Haller (2) found a nodule about the size and shape of a kernel of wheat at the point of bifurcation of the common carotid artery. Anatomic dissection revealed that the little body was inserted in the fibers of the sympathetic nerve plexus which forms a dense meshwork around the common carotid artery and its branches; it may be found either at the crotch of the artery or in its immediate neighborhood closely adhering to the wall of the vessel. The common carotid artery or one of its branches gives off a small vessel supplying the arterial blood.

[1] Further description of the tumor may be found in Dr. Wildner's article.

Von Haller (2) based his conclusions on the findings obtained by gross examination and regarded it as one of the numerous ganglia distributed into the course of the sympathetic nervous system. He named it "intercarotid ganglion," thus classifying it as a nerve-structure.

In 1862 Luschka (3) made several hundred examinations with the object of studying its anatomy. The carotid body was found in every case. This author was the first to make detailed microscopic examinations of the tiny organ.

According to his findings, the carotid body is a globular or oval-shaped structure measuring from 5 to 7 mm. in length, 2½ to 4 mm. in breadth and 1½ mm. in thickness. It is found either in the bifurcation of the common carotid artery or on the posterior wall of the internal carotid, so that it is not distinguishable anteriorly. For this reason it has been termed retrocarotid body by French writers.

Its color is a greyish red up to a shade of purple-red, depending on the amount of blood filling the capillaries. It is fairly dense, and occasionally it may be broken up into halves with more or less of a connecting link between, rarely in four or five particles which are scattered over quite an extended area and in the course of the internal carotid artery. In this respect it resembles the parathyroids, of which especially the upper one is sometimes divided into two or more units, with occasional cell-groups in the lateral lobes of the thyroid completely surrounded by thyroid acini. A homologous organ is present in all mammalian animals at the bifurcation of the carotid or in its vicinity.

On microscopic examination Luschka (3) found cells with a large protoplasmatic body grouped into clusters and strands of various size, a large number of thin capillaries surrounding the cell-clusters, and very numerous sympathetic nerve-fibers with scant ganglion cells. The parenchymatous cells were the characterizing feature and, assuming their epithelial origin, he presumed that the anlage of the carotid gland buds off from the epithelium of a branchial cleft. He regarded the enigmatic body as a gland closely attached to the cervical portion of the sympathetic nervous system, and applied to it the term "intercarotid gland." He placed it in series with the adrenals, the anterior or glandular lobe of the hypophysis, and the coccygeal gland.

The carotid gland, the anterior lobe of the hypophysis, and the coccygeal gland, though differing in minor details to the extent of establishing their individual independence, are similarly constructed: Large cells resembling epithelial cells arranged into lobules of various size and shape in close anatomic relation with the sympathetic nervous system. The coccygeal gland found just in front of the apex of the coccygeal bone and associated with the median sacral artery is about 2 to 3 mm. in diameter and bears closer resemblance to the carotid than to any of the other glands. It is a constant single organ. Not infrequently it is represented by five or six small nodules. It contains a great number of capillaries and many fibers from the ganglion impar of the sympathetic.

These organs belong to ductless glands, blood-vessel glands or glands with internal secretion, following Claude Bernard (4), who distinguished the external secretion of bile — through an efferent duct — from the storage and mobilization of glycogen as internal secretion.

It is interesting to note that thirty years before the first cases were reported by Marchand (5) and Paltauf (6), Luschka (3) expressed the opinion that the vestige of the carotid gland may give rise to the growth of tumors.

Arnold (7) took a view different from that of Luschka (3). He was impressed by the large number of capillaries which occasionally formed whorl-like structures comparable to glomeruli, and concluded that the organ was characterized by a network of capillaries, the walls of which were coated by large cells. To him it was a vascular structure which he named "intercarotid arterial glomeruli."

Waldeyer (8) accepted Arnold's (7) view in the main. He regarded the large epithelial-like cells as especially differentiated cells of the adventitia of the capillaries and therefore as constituents of the vessel-wall. He made a distinction between the endothelium of the capillaries and the large perithelial cells and introduced the term "perithelial

organ" for organs built on the plan of the carotid or coccygeal gland.

A new era has been opened by Schaper's (9) article on the histology of the carotid gland. He showed that many microscopic findings described as the carotid gland were artefacts due to autolysis of the very unstable protoplasm of the cells. He emphasized the examination of fresh tissue and demonstrated that only chromic acid or its salts were able to fix the cell structure in a way reflecting the picture of fresh tissue. He pointed out that the epithelial-like cell-groups, notwithstanding their close relation to the capillaries, are independent of them, the capillaries showing a continuous endothelial lining and the same structure as elsewhere in the body.

Stilling (10) agrees with Schaper (9) as to the independence of the cells from the capillaries, and he finds that some of the cells take a brown tinge after fixation with bichromate of potassium; the self-same cells are found in small corpuscles attached to the abdominal part of the sympathetic, which he is inclined to class as accessory adrenals. In summarizing he thus emphasizes the structural analogy of the carotid gland with the adrenals: "I believe myself to be able to confirm that the carotid gland, whatever be its embryonic origin, is neither a simple vascular network nor a rudimentary organ, but a 'blood-vessel gland' of a structure analogous to that of the adrenal."

In a very logical investigation, Alfred Kohn (11) showed why so many authors, though unraveling numerous elements of truth, failed to arrive at a satisfactory explanation. They had studied the fully developed organ and had allowed themselves to be carried away by some dominant features on which they laid undue stress. They had in turn regarded the minute structure as a ganglion, a gland, an epithelial organ, a vascular organ, and a rudimentary organ. Kohn took the position that the nature of an organ is determined by the nature of its specific cells. His was an histogenetic viewpoint, and he attempted to trace the development and the textural structure from the earliest stage up to the developed organ. First of all he disproved the alleged epithelial character of the cells. Epithelial cells are found lining outer or inner surfaces of the body; they show a clean-cut borderline toward the underlying connective tissue and a polar orientation, the free surface being differentiated from the base. The carotid cells are found in the midst of connective tissue and heaped up without any trace of orientation or polarity. He concludes that the utmost lack of regularity as to size and arrangement of the cells rules out their epithelial nature, and contends that they are a type of cell altogether different from epithelial, endothelial, or perithelial cells. Another peculiar feature of the cells is the unstability of their protoplasm. Specimens removed later than 45 minutes after death showed marked changes of the cells due to autolysis of the cell-substance. Experimentation with the various fixing fluids proved that only chrome salt solutions are likely to fix and preserve the protoplasm in its natural condition, at the same time staining it often a faint yellowish tint or any shade from a light yellow to dark brown. All other fixatives, as formalin, absolute alcohol, or sublimate, dissolve certain substances of the cell-body, the nuclei only remaining intact in a protoplasmic network with irregular meshes. Kohn named the cells "chromaffin cells" on account of their chemical affinity to chrome salt solutions. These cells are large and mostly polyhedric, though very polymorphous in appearance; the protoplasm is almost homogeneous or faintly granular. The nucleus is round or oval and shows a dense chromatin network with one or more nuclei and a sharply outlined nuclear membrane. Mitoses are found, though rarely.

A very large number of non-medullated nerve-fibers enter into the formation of the carotid gland; typical ganglion cells are found scattered or in small groups in the sympathetic nerve fibers. Kohn (11) then proved by comparative studies the close relation between the cells of the carotid gland — the chromaffin cell — and the non-medullated nerve-fibers. He found groups of chromaffin cells embedded in the sympathetic nerve-fibers (Fig. 1) running to the carotidgland much as ganglion cells are interwoven into the tracks of nerves. In the supreme cervical ganglion of the sympathetic

small groups of chromaffin cells are found. There is a continuous stretch of chromaffin cells extending from the carotid gland through sympathetic nerve-fibers to the supreme ganglion of the sympathetic. Here typical ganglion cells, chromaffin cells and nerve-fibers are found in closest union. The finding of the chromaffin cell — the characteristic element of the intercarotid gland — in sympathetic nerve-fibers and ganglia led to the assumption of a closely allied kinship between the carotid gland and the sympathetic nervous system.

Small islets of chromaffin cells are found in the sympathetic nerves and ganglia from head to coccyx (Fig. 2). Large autonomous organs are built up in the retroperitoneal space in close neighborhood to the abdominal aorta. The most proximal part of the abdominal paraganglion dips down into portions of the Wolffian body and the union of these two widely different organ-systems shapes the adrenal gland (Fig. 3). Its medullary part is a part of the sympathetic derived from the ectoderm, while the cortical part is part of the renal system derived from the mesoderm.

Another large paraganglion is the "accessory organ of the sympathetic" (Zuckerkandl (12)) found at the site of bifurcation of the abdominal aorta, which is well developed in the new-born, being 10–15 mm. in length and 3–5 mm. in width. Small paraganglia are found in the space betweeen the adrenals, kidneys and ureters, in the interiliacal angle, in the mesorectum and broad ligament (11) (Fig. 4). All paraganglia outside the adrenal medulla undergo involution after birth.

The chromaffin cell, which is the structural unit of the carotid gland, the medulla of the adrenal, and the accessory adrenals of the sympathetic, is a derivative of embryonic cells of the sympathetic. The embryonic cells of the sympathetic — sympathoblasts — differentiate into adult sympathetic ganglion cells and nerve-fibers, but some of them form chromaffin cells, *a cell which retains to a certain extent the features of the embryonic ganglion cells.* The author believes that the undeniable epithelial appearance which so deeply impressed itself on many workers may be a heritage of the epithelial origin of the nervous system, which traces its derivation back to ectodermal epithelium. Thus the chromaffin cell is closely related to the ganglion cell, but it does not form fibrils which are characteristic of the ganglion cell. Like the ganglion cell it appears either singly or in smaller or larger groups embedded in the track of sympathetic nerves, or, like the more differentiated ganglion cell, it may form individual organs. Kohn (11) introduced the term paraganglion for organs made up of chromaffin cells to express their histogenesis from the embryonic ganglion cell.

Another term "parasympathetic organs," expresses their histogenetic and anatomic relationship. Chromaffin cells develop in all parts of the sympathetic nerve anlage, in the cervical as well as the abdominal and sacral part of the sympathetic system; yet in certain locations they form large aggregations and independent organs. The intercarotid paraganglion, the adrenal paraganglion — the largest of the body — and the abdominal paraganglion are all made up of chromaffin cells derived from the embryonic sympathetic cell. They all retain their initial kinship with the sympathetic system in the fully developed organism.

In the human new-born chromaffin tissue is very widely distributed, but an involution sets in in early life and no chromaffin cell is found in the adult sympathetic (rests of chromaffin cells remaining in the carotid gland and the adrenal). In mammals it is a permanent structure (Vincent).

It has been shown in embryos of the cat, pig, and man that the cells of the intercarotid paraganglion develop from embryonic ganglion cells of the sympathetic at the ventral side of the internal carotid artery (Fig. 5). While the majority of the embryonic sympathetic cells develop into typical sympathetic ganglion cells and nerve-fibrils, a small number form sphere-shaped groups, the beginning of the alveolar structure of the zellballen (Fig. 6). These sharply defined zellballen are the unit of the adult intercarotid paraganglion; they take up at a later stage the chromaffin reaction. The fully developed organ then recedes from the wall of the internal carotid artery and descends to a point at or near the bifurcation;

on its way it has dragged sympathetic nerve-fibers with typical ganglion cells along, leaving in its trail a few scattered chromaffin cells. Kohn's (11) view of the nervous origin of the intercarotid paraganglion has been confirmed by subsequent investigations. It is interesting to consider that we have returned to the position taken by von Haller (2) in 1743. He based his sound and simple argument on the facts disclosed by gross dissection; slightly modified, his standpoint represents the best supported modern views.

In summarizing, one may say that the chromaffin cell — the structural unit of the intercarotid paraganglion — is found in the whole realm of the sympathetic nervous system, proving its histogenic unity. Although the chromaffin cells are derived from the sympathetic nervous system, yet there is good evidence that they perform an internal secretion in adult life. The internal secretion of the adrenal has been established since the time of Addison (13) in 1855. It is reasonable to use the term gland for secreting organs no matter what their morphologic origin is. Apparently the terms paraganglion and gland will be used promiscuously for the aforesaid organs, depending on the point from which they are viewed. There seems to be a close union between the nerve and vascular system in the paraganglia, the chromaffin cells throwing their secretion directly into the circulation under the stimulation of the sympathetic nervous system.

*Physiology.* The intercarotid paraganglion shows, like all other paraganglia, an extremely rich vascularization. This fact in itself seems to indicate a very active metabolism. Only the largest paraganglion of the body, the medulla of the adrenal, has thus far received due attention. Adrenalin, when administered intravenously, will cause marked increase of arterial blood pressure, due to its contracting effect on the unstriped muscle-fibers of the arterial wall, combined with decrease in pulse rate and increase of the force of the heart beat. Glycosuria also results. Claude Bernard (4) produced glycosuria by stimulation of a point at the floor of the fourth ventricle and concluded that the stimuli traveled by way of the sympathetic system to the liver, causing a glycogenolysis. In recent studies on rabbits it has been shown that this experiment fails after removal of the adrenals or severance of the sympathetic or splanchnic nerve. In the light of this additional knowledge it seems that stimulation of certain points of the brain may be conveyed in the track of the sympathetic to the adrenal medulla, causing a secretion of adrenalin with its glycosuric effect. Adrenals removed from animals on which Bernard's (4) experiments had been made showed a lesser pressor effect on the vascular system than the intact adrenal; and microscopic examination disclosed diminution or absence of the chromaffin reaction of the cells of the medulla. The various stages of physiologic activity of the secreting cells correspond to definite morphologic pictures, and the secretion appears in the shape of droplets which are evidently thrown into the thin-walled capillaries.

Josue (14) found in rabbits which he had injected for some time intravenously with three drops of adrenalin 1:1000, arteriosclerosis of the aorta and larger arteries.

There are some observations that seem to lead to the assumption of an important rôle played by the intercarotid gland. The wealth of sympathetic nerves running into it, the chromaffin cells in immediate contact with capillaries, only a thin endothelium intervening, the unstability of its protoplasm, and its rapid autolysis after death seem to indicate the presence of a highly sensitive chemical substance.

The writer was able to find only a single instance of an experimental investigation into the function of the carotid paraganglion. Frugoni (15) cites Vassale (16) who noted, after bilateral destruction of the organ, a considerable glycosuria of a passing nature or cachexia leading to death. Frugoni (15) showed that intravenous injection of 5 ccm. press juice obtained from the carotid glands of suckling calves would kill a rabbit in one or a few minutes; there were convulsions, paralysis of respiration, and failure of heart action. The blood of the injected animal lost its clotting property and the visceral organs were markedly hyperæmic. The main action seems to be on the vascular system. Small doses of

extract have a depressor effect on the vascular system; it is antagonistic to adrenalin.

*Pathology.* Marchand (5) published the first case of a tumor of the intercarotid paraganglion in 1891. Paltauf (6) reported four cases in 1892. The most striking feature of all these tumors was their location at the angle of bifurcation of the common carotid and their close adherence to the wall of the arterial vessels. In four out of these five reported cases the tumors could be removed only with resection of the common carotid artery and its branches, while in the fifth case the tumor was shelled out without damage to the vessels. The tumors showed also a great similarity in their microscopic structure. Marchand (5) concluded that the tumor was of a peculiar structure, which could be derived only from a certain well-defined anlage. Paltauf (6) regarded the four tumors he reported as peritheliomas of the carotid gland. The conclusions arrived at by these two authors are the more convincing as they were drawn independently. Since then, about 35 cases of tumor of the intercarotid gland have been reported in the literature. With three exceptions they were all removed by operation. The three tumors found at post-mortem are among the smallest in the series, being about the size of an almond or English walnut. The typical location of the tumors is the angle of the bifurcation of the common carotid, the growth as a rule adhering to the wall of the artery. Sometimes the common carotid artery is seen passing into the tumor (Scudder (17)). In other cases the arteries lie in deep grooves in the tumor.

When the tumor is firmly adherent to the wall of the vessel its removal is feasible only after resection of the common carotid artery and its branches. In some cases the internal jugular vein, the sympathetic, vagus, hypoglossal and lingual nerve have been removed together with the carotid tumor. In a few cases the tumor, being loosely attached to the wall of the vessel, could be shelled out without damage to the arteries, or with ligation of the external carotid only (6, 18, 19, 17, 20).

The size of the tumor, which is well encapsulated, may be that of an almond, usually that of a hen's egg, and in some cases of a goose egg. Some have the shape of a potato and have been termed "potato tumors" of the neck.

The color depends on the color of the tissue proper and the amount of blood filling the capillaries. It may be a white, reddish grey, brownish red or even dark purple. The transparency and the glossy appearance of a freshly cut surface have been noted in several cases, occasionally reminding one of a parenchymatous goiter (1). The consistency depends on the relative amount of cells and fibrillary tissue; it may be firm, hard, rather elastic, or sometimes as soft as brain tissue. The capsule is fibrous, smooth, thin and contains a large number of thin-walled veins. Fine strands of connective tissue run from the capsule toward the center, producing a lobulated appearance, and a sponge-like structure is produced by the presence of very numerous enlarged capillaries. The cut surface is characterized by its homogeneity and evenness of texture. In several cases that came to post-mortem a search was made for the intercarotid paraganglion at the bifurcation of the vessel and in the surrounding tissue, but no trace of it could be found, while it was invariably present and of normal size on the other side. It was further observed that the tumor derived its arterial blood supply from the common carotid or from one of its branches near the bifurcation in the same manner as does the intercarotid gland. The stroma of the tumors is usually more developed in the center than on the periphery.

On going over the tumors of the intercarotid gland one is impressed by the almost perfect identity of the salient features of all of them. There are certain differences in the various individual tumors and there are variations in the pictures of sections taken from various places, but these differences appear secondary and are due to degenerative changes that have taken place.

Microscopically the tumors show an alveolar structure with thin capillaries forming the stroma. The cells of the alveoli are grouped irregularly and show a homogeneous protoplasm without partitions between the individual cells. In other cases the cells are rather well defined, polyhedric or round. The

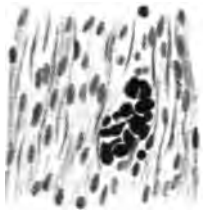


Fig. 1.

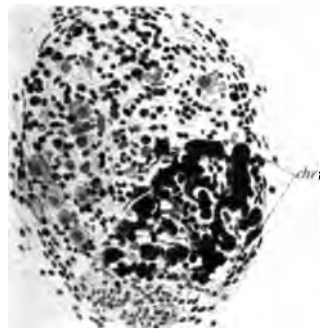


Fig. 2.

Fig. 1. Sympathetic nerve from the vicinity of the carotid paraganglion. In the midst of it a group of chromaffin cells.

Fig. 2. Sympathetic ganglion from the pelvic portion of the ganglion cord (fœtus of 7 months). One-half of the ganglion taken up by the chromaffin cells (chrz). (From A. Kohn.)

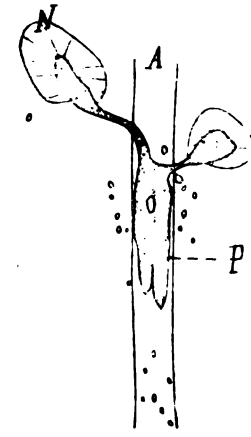



Fig. 3.

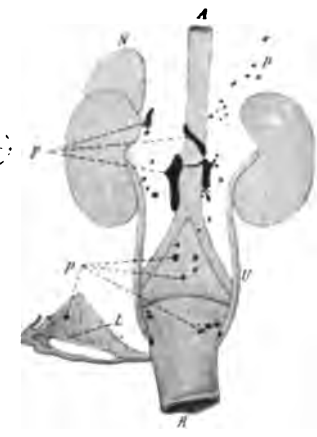



Fig. 4.

Fig. 3. Paraganglion of a new-born rabbit. Diagrammatic drawing, 10 X. A, aorta; N. adrenal; P, aortic paraganglion forms the medulla of the adrenals with its cranial terminals. (From A. Kohn).

Fig. 4. Paraganglia of a girl (45 days old). A, aorta; N, adrenal; U, ureter; R, rectum; L, broad ligament; P,p, major and minor paraganglia. On the left the adrenal has been removed in order to show the paraganglia on its posterior surface.

nuclei are round or oval, sharply outlined, showing a number of chromatin nodules immediately below the vesicular membrane, and resembling plasma cells. Mönckeberg (21) noted in two of his cases that the protoplasm of specimens fixed in Müller's or Zenker's fluid showed excellent preservation, while another tumor fixed in formalin showed the same foam-like structure of its cells as is shown by the formalin-fixed cell of the normal organ. He laid stress on this reaction as being the chemical proof of the origin of the tumor from the carotid gland. A few of the cells of one of his tumors took up the yellowish tinge characteristic of the chromaffin cell.

The capillaries show a continuous endothelial lining, the cells being set directly on the endothelium. The width of some capillaries is remarkable and accounts for the porous structure of some of the tumors. Hyaline degeneration is apt to set in in the walls of the capillaries, especially in the center of the growth.

Syncytial cell groups and giant cells are occasionally observed. Karyokinetic figures are seen in the tumors, sometimes in large numbers.

Tumors of the intercarotid paraganglion are made up of chromaffin cells, the elements which form the normal structure. Whenever a tumor of a paraganglion — a paraganglioma — is suspected, it should be fixed in a solution containing chromic acid or its salts. A mixture of ten volumes of 3½ per cent solution of bichromate of potassium and one volume of formalin gives an excellent fixative. After 24 hours' fixation the tissue should be mordanted in the bichromate solution for two days, then treated in the usual manner. The intercarotid gland may be divided into several portions and chromaffin cells found in places distant from the bifurcation. We may then find chromaffin tumors at a distance from the bifurcation, for instance at the jaw (22).

The tumors of the carotid paraganglion are rather benign, slow-growing neoplasms. They begin as hypertrophies of the normal organ and grow 5, 10, even 37 years (19) without causing any discomfort. Though they adhere very closely to the arteries, only one case hitherto reported (Marchand's (5)) showed penetration of the arterial wall and two small nodules of tumor tissue in the lumen, one exactly at the bifurcation and another a little higher up in the external carotid.

In the case herein reported, the tumor was removed from the right side of the neck of a woman 34 years of age. After multiple adenomas of the thyroid had been removed a mass

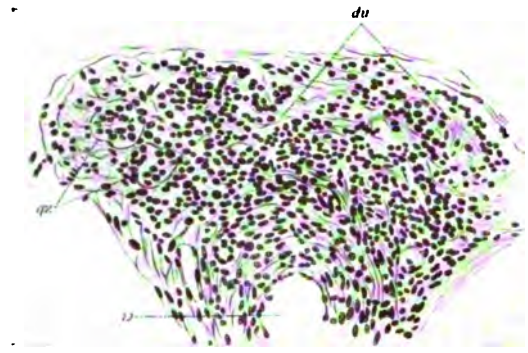


Fig. 5. Pig embryo, 45 mm. Section through nerve-plexus (n.p.) at ventral side of internal carotid (c.i.). Ganglion cells in diffuse arrangement. Grouping of cells into acini (z.b.) the anlage of the carotid paraganglion. (From A. Kohn).

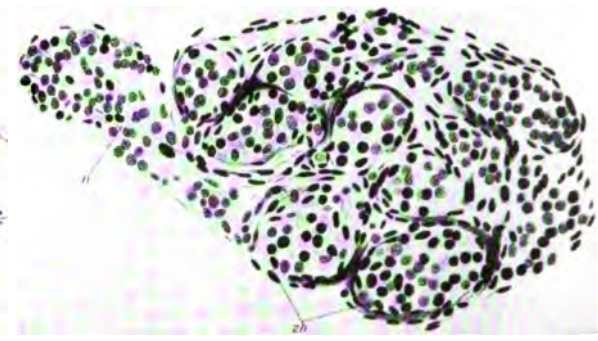


Fig. 6. Pig embryo, 87 mm. The cell alveoli (z.b.) have increased in size and multiplied. The organ shows the finished appearance. (From A. Kohn).

was found lying high up in the neck running up to the angle of the jaw, very densely adherent to all surrounding structures involving the internal jugular vein, a portion of which was removed with the tumor. The tumor measured 5 x 7 x 4 cm., was well encapsulated (Fig. 7), and could be shelled out without injury to the arteries. It was of a greyish red color, very even on section, of a "live rubber" consistency and remarkable transparency (Fig. 8). The internal jugular vein was loosely plugged with tumor tissue, 4 cm. in length. The microscopic structure is analogous to the previously reported cases (Figs. 9 and 10).

Metastases in lymph-nodes have been noted in a few cases. Recurrences have been noted in about one-fourth the cases. Hyalin degeneration of the capillaries has been noted in a good many cases.

*Systemization.* The study of the organogenesis of the intercarotid paraganglion has shown its origin from the primitive sympathetic anlage and has attached this apparently isolated and vestigial corpuscle to the sympathetic nervous system. The embryonic sympathetic cell — sympathoblast or sympathogonia — develops into the sympathetic ganglion cell and nerve-fiber on the one hand and the chromaffin cell on the other.

Sympathoblast (Sympathogonia, embryonic sym. cells)

| | |
|---|---|
| Sympathetic ganglion cell and nerve-fibers. | Chromaffin cell (Paraganglion, parasympathetic organ). |

It is interesting to examine the neoplasms of the sympathetic in the light of the facts put forth. Elements representing the various stages of embryonic development and differentiation may go into the making of sympathetic tumors.

Sympathoblastoma (Lympathogonoma, ganglioma, embryonale sympathicum)

| | |
|---|---|
| Ganglioneuro (fibro) ma. | Chromaffin tumor (Paraganglioma Parasympathoma). |

Tumors consisting of these elements may occur at any point of the central nervous system—on the cerebrospinal nerves, on the sympathetic with its distribution, and in the visceral organs.

The sympathoblastoma may occur anywhere within the boundary of the sympathetic, preferably in the adrenal medulla of newborns or children. It is a malignant tumor with metastasis to the liver and other organs (23, 24, 25, 26, 27, 28, 29, 30). Full-blown ganglion cells and nerve-fibrils constitute the ganglio (neuro) fibroma. They may arise from the ganglionated cord (31, 32, 33); they may be interposed between kidney and adrenal (34), or between spine and kidney (35). Wegelin (36) found 14 out of 18 cases of the ganglionated cord on the left side. Herxheimer (37) found among 28 tumors 17 arising from cord ganglia, 11 from the medulla of the adrenal or its vicinity.

A chromaffin tumor — a paraganglioma — may develop from any paraganglion of the body; so far only few tumors have been ascer-

Fig. 7. Case No. 82318. Outer surface of tumor with resected internal jugular vein at upper pole plugged by tumor-tissue.

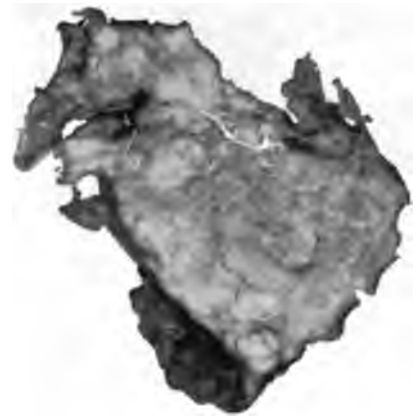


Fig. 8. Case No. 82318. Cross section of same tumor.

tained (38, 39, 21, 40, 41, 42, 43). These cases are tumors of the adrenal and intercarotid paraganglion and the coccygeal gland.

The adrenal medulla may develop all the possible tumors of the sympathetic tissue; the embryonic neuroblastoma, the ganglioneuroma and the chrome-brown tumor or paraganglioma. The cortex of the adrenal produces the so-called adrenal hypernephroma as typical tumor (44, 45).

Sacrococcygeal tumors should be carefully examined for the presence of chromaffin cells; they may be derived from the coccygeal gland (40, 46). Tumors of the nervous system should be fixed in a formalin bichromate mixture in order to preserve the chromaffin cells.

*Excessive and defective physiologic activity associated with tumors of the glands of internal secretion.* What is the relation between the neoplastic cell and its normal mother-cell as to physiologic function? From microscopical examination, production of bile by the cells of a carcinoma of the liver and production of colloid in carcinoma of the thyroid have been known for a long time. The metastases of these tumors may occasionally secrete bile or colloid. Even under such conditions as exist in the bone-metastasis of a thyroid carcinoma, colloid in the acini has been seen. On the other hand, we have clinical evidence that the carcinoma of the thyroid may aggravate the symptoms of hyperthyroidism. A degenerating fœtal or adult adenoma may produce toxic symptoms without exophthalmos (45).

Assuming a correlation between the changes in form and the changes in function, we may expect a hyperplasia of an organ to be combined with a hyperfunction, perhaps followed later on by hypofunction with the beginning of secondary tissue degeneration. Acromegaly is associated with an adenoma of the eosinophilic type of the anterior lobe of the hypophysis (47, 48).

Tumors arising from the posterior lobe of the hypophysis may bring about the clinical symptoms of a high limit of sugar assimilation, adiposity, lowered blood pressure, slowed pulse, subnormal temperature, asthenia, and drowsiness (49).

Neoplasms of the pineal gland of young males may bring on rapid growth of stature, hirsuties and a premature sexual development, with corresponding change of the frame of mind (50).

Of the tumors of the adrenal we have to differentiate between those arising from the cortex and those from the medulla. The adrenal hypernephroma is apt to produce abnormal sex characteristics when present in females. The symptoms seem to be the more pronounced the younger the individual. Hirsuties, especially on upper lip, neck and chin, and chest, cessation of menses, atrophy of uterus and ovaries, obesity, and a change of voice have been observed (51); in men, a

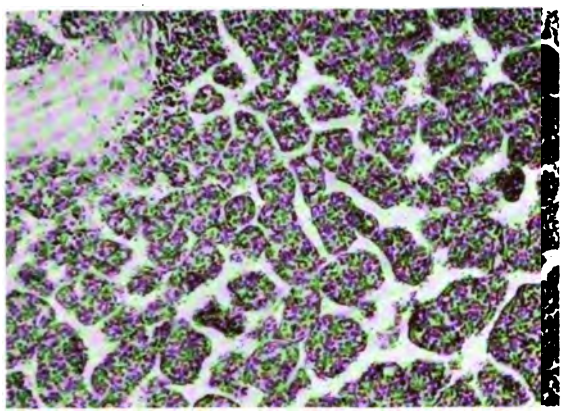


Fig. 9. Case No. 82318. Microscopic section, low power, showing the capillaries and alveolar cell-groups.

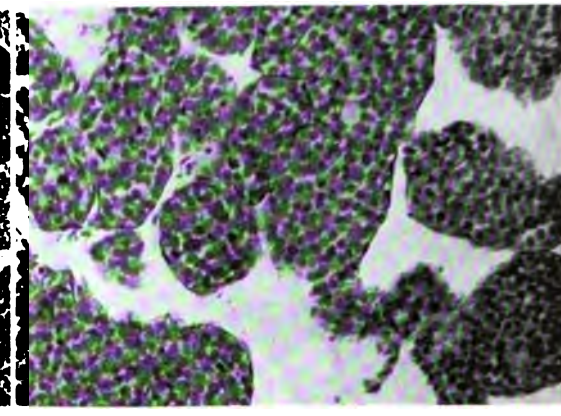


Fig. 10. Case No. 82318. Same section, high power, capillaries with a continuous endothelial lining. Note the nuclei of endothelial cells.

gigantic increase in bodily strength has been observed (45).

Chromaffin neoplasms of the adrenal medulla, with the symptoms of hyperfunction of the adrenalin-producing tissue, were observed in a few instances. The clinical symptoms were those that can be experimentally produced by repeated adrenalin injections: glycosuria, hypertrophy of the heart, especially of the left ventricle, high blood pressure, arteriosclerosis (found in a baby 2 years of age) (52).

In view of these observations on the evidence of physiologic function in the cells of neoplasms of glands of internal secretion, one would expect to find evidence of the physiologic function in the presence of the enormous overgrowths of the intercarotid gland. In none of the reported cases of tumor of the intercarotid gland has a hyperfunction of chromaffin tissue been noted; perhaps one of the reasons may be that it has never been looked for.

Function, pathology and clinical manifestations of the chromaffin system, the intercarotid gland in particular, are little known, and the cases of tumor of the carotid gland have usually been diagnosed at the operating table, after having been designated as lymphoma or adenoma of the thyroid. The tumors of the intercarotid glands are by no means as rare as has been generally supposed. The Index Medicus shows three papers for the first six months of 1913.

It would seem rational that in cases of tumors of the carotid gland the whole chromaffin system be examined and evidence of its hyperfunction be carefully sought after. The writer would tentatively advance the hypothesis that the carotid gland tumor is but an anatomic expression of a functional disorder of the chromaffin system, affecting one or more units of the same. A bilateral overgrowth of the carotid gland has been observed by Enderlen (53).

## REFERENCES


1. KEEN. J. Am. M. Ass., 1906, xlvii, 469.
2. VON HALLER. Elementa physiologiæ corporis humani, iv, p. 1766.
3. LUSCHKA. Arch. f. Anat. u. Physiol., Leipz., 1862.
4. BERNARD.
5. MARCHAND. Festschr. f. Rudolf Virchow, Berl., 1891, i, 547.
6. PALTAUF. Ziegler's Beitr., 1892, xi.
7. ARNOLD. Virchow's Arch. f. path. Anat., etc., Berl., 1865, xxxiii.
8. WALDEYER. Virchow's Arch. f. path. Anat., etc., Berl., 1872, lv.
9. SCHAPER. Arch. f. mikr. Anat., Bonn, 1892, xl.
10. STILLING. Anat. Anzeiger, 1898, xv; Recueil inaugural de l'Université de Lausanne, 1892.
11. KOHN. Prag. med. Wchnschr., 1902, No. 27; Arch. f. mikr. Anat. u. Entw., 1903, lxii; Allg. Wien. med. Ztg., 1903, xlviii, 503.
12. ZUCKERKANDL. Verhandl. d. anat. Gesellsch., Jena, 1901, May, xv.
13. ADDISON. "On the Constitutional and Local Effects of Disease of the Suprarenal Capsules." London, 1855.
14. JOSUE. Compt. rend. Soc. de biol., Par., lv, p. 1374.
15. FRUGONI. Il Policlin. sez. med., 1913, xx, cit.
16. VASSALE. Cit. by Frugoni.

17. SCUDDER. Am. J. M. Sc., 1903, CXXVI, 384.
18. KRETCHMAR. Über eine Geschwulst d. gl. carotica, 1893.
19. HEINLETH. München. med. Wchnschr., 1900, June 26, p. 899.
20. BALFOUR. Loc. cit.
21. MÖNCKEBERG. Ziegler's Beitr., 1905, XXXVII.
22. VIGNARD and MOURIQUAND. Rev. d. Chir., 1905, XXXII, 467.
23. KRETZ. Lubarsch Ostertag's Ergeb., Abt. 2, 1902.
24. WRIGHT. J. Exp. M., 1910, xii, 556.
25. PICK. Berlin klin. Wchnschr., 1912, No. 12.
26. LANDAN. Frankfurt Ztschr. f. Path., 1912, xi, 26.
27. DALTON. Tr. Lond. Path. Soc., 1885, XXXVI, 247.
28. HEATON. Tr. Brit. Path. Soc., 1898, xlvi, 140.
29. TILLESTON and WOLBACH. Am. J. M. Sc., 1908, CXXXV, 871.
30. MARTINS. Frankfurt Ztschr. f. Path., xii, No. 3.
31. CHIARI. Verhandl. d. Naturf. Ver., Düsseldorf, 1898.
32. WILLIAMSON. Brit. M. J., 1899, ii, 10.
33. WOODS. Prag. med. Wchnschr., 1906, 646.
34. SCHMIDT. Virchow's Arch. f. path. Anat., etc., Berl., 1899, clv, 557.
35. MILLER. Virchow's Arch. f. path. Anat., etc., Berl., 1908, CXCI, 411.
36. WEGELIN. Ziegler's Beitr., 1909, xlvi, 403.
37. HERXHEIMER. Ziegler's Beitr., 1913, lvii, 112.
38. MANASSE. Virchow's Arch. f. path. Anat., etc., Berl., 1893, CXXXIII; Ibid., 1896, CXLV.
39. STANGL. Verhandl. d. path. Gesellsch., 1902, 250.
40. ALEZAIS and PEYRON. Compt. rend. Soc. de Biol., Par., 1909, 1121.
41. SUZUKI. Berl., klin. Wchnschr., 1909, 1644; Ibid., 1910, 1623.
42. WEGELIN. Verhandl. d. path. Gesellsch., 1912, 255.
43. KAWASHIMA. Virchow's Arch. f. path. Anat., etc., Berl., 1911, cciii, 66.
44. GLYNN. J. Path. & Bacteriol., 1913, xviii.
45. WILSON. J. Med. Research, 1911, xxiv, No. 1; Old Dom. J. Med. & Surg., 1910, x, No. 4, Apr.
46. HLEB-KOSZANSKA. Ziegler's Beitr., 1904, XXXV, 589;
47. FISCHER. Hypophysis, Akromegalie, Fettsucht. Wiesbaden, 1910.
48. LEWIS. Johns Hopkins Hosp. Bull., 1905, xvi, 157.
49. CUSHING. "The Pituitary Body and Its Disorders," 1912.
50. FRANKL-HOCHWART. Deutsche Ztschr. f. Nervenh., Leipz., 1909, XXXVII, 455.
51. GLYNN. Quart. J. Med., Oxford, 1912, v, 157.
52. NEUSSER-WIESEL. "Die Erkrankungen der Nebennieren," 1910.
53. ENDERLEN. Personal communication.

# CONCERNING APPARENT CURES OF RENAL TUBERCULOSIS

By E. L. KEYES, Jr., M. D., New York City

AMONG the many interesting features of renal tuberculosis none is more important than the apparent cures of the disease. The dispute between the relatively few practitioners who would treat renal tuberculosis without operation and the many who urge prompt nephrectomy, as soon as the diagnosis is made, can only be settled by a clearer understanding of what the apparent cure of renal tuberculosis means. The underlying difficulty in reconciling the opposing views is probably a lack of thorough understanding of the relation between the pathological lesion in the kidney caused by tuberculosis and the symptoms arising therefrom. Thus it is not generally appreciated that the variations in the patient's general health as well as in his renal or vesical symptoms are due to alterations in retention (renal or vesical), or to changes in the activity of pelvic or vesical lesions, rather than to changes in the kidney parenchyma.

Every case of early renal tuberculosis submitted to operation places in our hands a pathological specimen suggestive of the fact that the renal lesions are far older than the duration of symptoms would suggest. Indeed, the mere presence of surgical tuberculosis in the parenchyma of the kidney causes no symptom. Upon this fact it is scarcely necessary to insist. The familiar case history with its exclusively vesical symptoms is sufficient evidence that the lesion in the kidney parenchyma does not make itself felt until one of two things happens. Either it extends through the capsule and excites perinephritis, or else it extends to the pelvis and there sets up a tubercular pyelitis.

Perinephritis is rare, and need not concern us.

Tubercular pyelitis is common. Doubtless the painful and frequent urination, which is so often the most prominent early symptom of the disease, is at the outset due entirely to tuberculosis of the pelvis and ureter. Judging from the specimens I have seen, this tuberculosis usually takes the form of a disseminated, subepithelial infiltration of the mucous membrane with little tubercles which give to the mucosa a pebbled appearance, similar to that produced by pyelitis cystica.

At this early stage, the cavity of the kidney pelvis is usually very slightly dilated (apparently by relaxation of its walls). There may be no ulceration excepting that upon the papillæ, the source of pelvic infection. Yet even with lesions so slight as these, the patient may be urinating every hour, with considerable straining and terminal pain. If the kidney is removed at this time, the frequent urination is checked as if by magic and does not return.

The next important pathological change consists in the extension of the tuberculosis to all the layers of the pelvis and ureters and to the bladder. Upon the mucous surface the tubercles ulcerate, and upon the outside they excite that adhesive inflammation about the pelvis and ureter, with irregular thickening of the walls of these channels, which is so characteristic of renal tuberculosis. As a result of this ulceration and infiltration, the lumen of the excretory channel becomes more or less completely obstructed and the region above the obstruction dilates. Inasmuch as the cavity of the kidney pelvis itself often becomes almost completely obliterated by this process, the dilatation may affect only one portion of the kidney, though it usually affects the whole kidney. Exceptionally the obstruction is in the ureter and the pelvis itself is widely dilated instead of being contracted.

As a result of these pathological changes, renal colic may occur from the passage of blood clots or shreds of fibrin or tissue, or pain in the loin may result from distention of the kidney, or perinephritis; while a more or less definite sensitiveness and dragging pain in the side may result either from the tension in the kidney and its pelvis, or from the dragging of the shortened and thickened ureter, or from perinephritis.

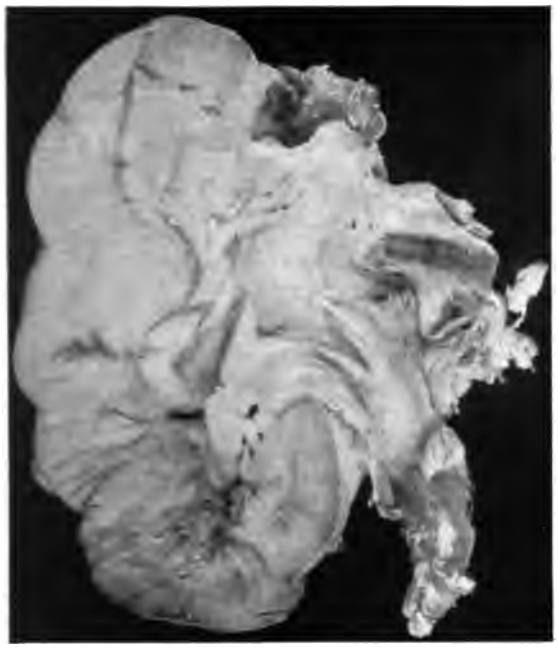


Fig. 1. Kidney sclerotic, pelvis a little thick. Ulcerated papilla at lower pole. The caseous upper pole has been torn away.

Fig. 2. Leaded catheters in both ureters. Collargol injection of right kidney (left in figure) shows dilated calyces and suggests enlargement of lower pole.

But if the ureter is not shortened, and if the retention either in one pole of the kidney, or the whole kidney, is sudden and complete instead of being gradual and incomplete, the patient's discomfort may suddenly cease (either with or without renal colic). Even though the tuberculosis has extended down the ureter beyond the point of stoppage, if urine ceases to flow through the ureter the symptoms will promptly cease, whether the flow of urine be checked by nephrectomy or by plugging of the duct.[1]

In the light of these facts, the varying history of patients with renal tuberculosis is readily understood. The great majority of them constantly have frequent and painful urination, and though from time to time very considerable remission of the symptoms may occur, these never entirely disappear, and as the inflammation progressively invades more and more of the bladder the general tendency is for the urinary distress to become more and more marked. Some patients fail rapidly in general health on account of partial retention, usually in the kidney pelvis, less often in the bladder. But the exceptional patient may continue to have fairly good drainage and exhibit the most extraordinarily good general health.

On the other hand, once in a long while, one encounters a case of renal tuberculosis whose symptoms have suddenly and completely ceased and who has apparently regained perfect health without operation. Such a case I have seen but once. The patient suffered in the early '90's from many renal colics upon the right side and from a certain amount of bladder irritation. Tubercle bacilli were found in the urine. In 1895 Dr. McBurney explored the right kidney but failed to find anything wrong with it and did not remove it. Within a few days of this operation, the patient had a frightful renal colic, and thereafter all of his symptoms ceased. He remained entirely well until 1912, when he again began to have pains in the right side and rapidly lost weight. At the time I saw him the right ureter seemed

[1] Indeed, it seems possible that partial obliteration of the kidney, resulting in stoppage of the infected flow, but with no stoppage of the *uninfected* urine, may equally be followed by cessation of symptoms.

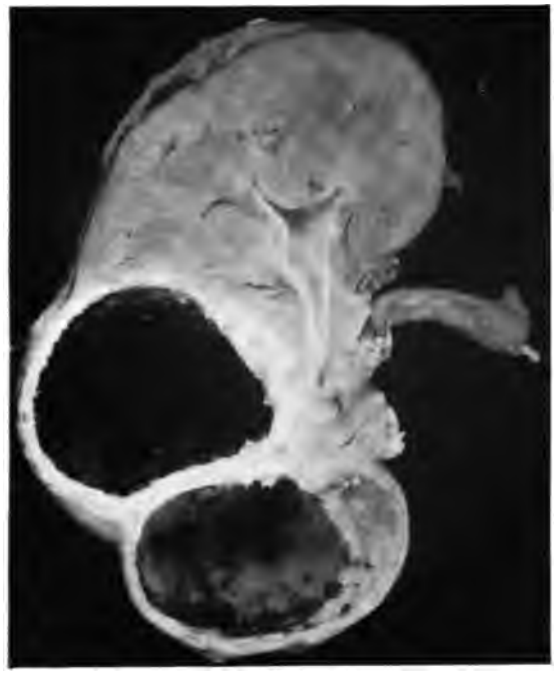


Fig. 3. Parenchyma normal. Pelvis pebbled. Cystic lower pole due to healed tuberculosis.

absolutely occluded: it transmitted no urine and would admit no catheter, while the left kidney and bladder seemed entirely normal. The diagnosis of carcinoma of the gall-bladder and liver was made and confirmed by the prompt death of the patient. The right kidney had evidently ceased to functionate at the time of the last renal colic and had been a dead organ for 17 years, thereafter. With its shutting off the lesion lower down the urinary tract subsided.

That this is an unusual case is attested by the experience of every one of us. I have operated upon thirty-one cases of renal tuberculosis and seen perhaps as many more who have either been operated upon by other surgeons or who have refused operation, and never yet have I seen its mate. Several of my cases, however, have shown for long periods of time a very considerable remission of symptoms. Two of them have remained entirely without symptoms, respectively, for two and six years, at the end of which periods the symptoms returned and I removed the kidney.

The first of these patients, an Irishman, 27 years of age, came to St. Vincent's Hospital in February, 1911, giving the following history: Never had venereal disease; was a heavy drinker; had pneumonia two years before admittance and showed a scar on his neck from a gland which suppurated at that time. His urinary history was one of hæmorrhage; six years before he had had a profuse, spontaneous, painless hæmaturia. This ceased after a day or so. Three months before admission the bleeding reappeared and lasted two days. At the time of entering the hospital he had been bleeding again for seven days. He showed no other symptoms relative to his urinary organs and had lost no weight. As soon as he entered the hospital the bleeding stopped and he went through an attack of delirium tremens, lasting two weeks. At the end of this time physical examination revealed a very large, low kidney on the right side and a slight pulmonary dullness at the left base. In 24 hours he passed 47 oz. of urine containing 1.3 per cent urea, some red and white blood cells, and no pus. Phenolsulphonephthalein was injected and after a delay of 12 minutes he passed 20.5 per cent in the first hour and 8.9 per cent in the second.

Cystoscopy showed a normal bladder and normal ureter orifices. No. 6 flute tip ureter-catheters were readily introduced 25 ccm. into each ureter and in the first 8 minutes 5 ccm. of urine were obtained from the enlarged right kidney, containing, besides the usual blood and epithelial cells, numerous casts, a few leucocytes and 1.3 per cent urea; while from the left one only 3 ccm. were obtained with 0.3 per cent urea, no pus and no casts. The phenolsulphonephthalein appeared in 8 minutes from the right kidney; in 9 from the left. In the first 30 minutes, thereafter, 3 per cent was excreted from the right side, only a trace from the left and in the following 30 minutes 5.6 per cent from the right side and 1.7 per cent from the left. There was no pus in any of the urinary specimens.

Here was a curious state of affairs: The patient's symptoms suggested tumor, and the marked enlargement of the right kidney suggested that the tumor was unquestionably on the right side, yet the functional test showed a great deficiency in the excretion, both of urea and phenolsulphonephthalein from the left kidney. Accordingly I cut down, first upon the left kidney, found its upper third converted into a cheesy mass, obviously an ancient tuberculosis. Turning the patient over, a small incision sufficed to reveal that the right kidney was very low, hypertrophied to twice its normal size, but otherwise apparently normal. Turning back to the left side, I therefore removed the left kidney; the patient making an uneventful recovery. Maximum temperature after the operation was 100.4° F., and the wounds healed by primary union.

On looking back at the case, the presence of the casts in the urine from the right kidney and the markedly deficient excretion from the left side, together with the absence of casts, should have warned me of the presence of

renal tuberculosis on that side, had I but seen some pus. For casts on one side and deficient function with pus and without marked enlargement of the kidney upon the other side is very suggestive of unilateral tuberculosis.

But the second, and for our present purpose the most important, feature of this case is the distribution of lesions of the infected kidney (Fig. 1). Its upper pole was converted into a cheesy mass; the remainder of the kidney showed a few evidences of beginning tuberculosis scattered here and there, the most notable of which was an ulceration upon one of the lower papillæ. The pelvis of the kidney was not far from normal. We may make the pathological and clinical pictures coincide by assuming that the original lesions were at the upper pole and closed with caseation of that pole, that the kidney pelvis was but little infected, and that with spontaneous shutting off of the tuberculous lesion in the upper pole, the whole process became quiescent for six years, only to break out again with precisely the same process at the lower pole. If this patient had come to autopsy after being killed in an accident, at some time between the first and second outbreaks of his renal tuberculosis, his kidney might have gone down in history as proof that renal tuberculosis can and does heal with only partial destruction of the parenchyma. Fortunately, the science of medicine has been spared this shock.

My second case illustrates this temporary healing after partial destruction of the kidney even more strikingly. The patient, a woman 38 years of age, was brought by her physician for cystoscopy in July, 1910. She was in excellent general health and complained only of a spontaneous "cystitis" (i. e., frequent and painful urination with pus) of six months' duration, which had been entirely uninfluenced by treatment, but had ceased spontaneously a month before she came to me. A few days thereafter she had a single hæmaturia. Cystoscopy showed nothing abnormal in the bladder excepting a swollen, inflamed right ureter orifice. The ureters were both readily catheterized to the renal pelvis. Five ccm. of indigo-carmin was injected; this appeared from the left kidney in 13 minutes; from the right in 32 minutes. The urine from the left kidney contained 1.8 per cent urea, no pus and no casts; that from the right kidney contained 1.2 per cent urea, pus, no casts and no tubercular or other bacteria, by smear. Guinea pigs were inoculated with the bladder urine and survived.

She was seen again in November, 1910, and November, 1911, each time free from symptoms, but passing urine which contained a very faint trace of albumin and a few pus cells.

On January 31, 1913, she returned, stating that after a slight vesical irritability which had lasted for two months, she was suffering a distinct bladder irritation for two days. Cystoscopy showed a little vegetating mass at the right ureter orifice and some inflammation about this. Ureter catheterization drew from the right kidney urine containing 0.4 per cent urea, pus and tubercle bacilli by smear; while the urine from the left side showed 0.75 per cent urea and a few leucocytes. The X-ray showed an enlarged right kidney and an injection of collargol into this (Fig. 2) showed that while the pelvis was not dilated the enlargement was chiefly confined to the lower pole.

Upon these findings the right kidney was removed. Its lower pole was found replaced by two large cysts, containing bloody serum. The remainder of the kidney was so normal that a most competent pathologist was unable to find any lesions in it even suggestive of kidney tuberculosis (Fig. 3). But the pelvis, though normal in every other respect, was studded with little spots which proved on section to be miliary tubercles. Her symptoms ceased upon removal of the kidney; her wound healed by first intention.

Here, then, is a second case of partial healing of renal tuberculosis with remission of symptoms for two years. As we look at these two specimens, I think we may anticipate the day when specimens similar to these shall be made the basis of a plausible but entirely unwarrantable pathological attack upon nephrectomy for the cure of renal tuberculosis. To forestall this is my excuse for presenting them before you.

# THE RÖNTGENOGRAPHIC DIAGNOSIS OF GALL-STONES AND CHOLECYSTITIS[1]

BY LEWIS GREGORY COLE, M. D., NEW YORK CITY
Professor of Radiology, Cornell University Medical College

THE röntgenographic diagnosis of gall-stones and cholecystitis is a subject that has interested röntgenologists and diagnosticians since the earliest use of the X-rays. It seemed reasonable that the röntgenographic method of detecting renal calculi would likewise reveal biliary calculi. But repeated failures led most of us to abandon hope, and for a long time not even to attempt the examination. With the increasing number of cases examined, and the use of an intensifying screen and soft tube, gall-stones were occasionally detected. This led me to the routine examination for gall-stones in all cases presenting symptoms referable to the right hypochondrium. The number of positive diagnoses which I have been able to make proves that the examination is justified; but a negative diagnosis should never be made where there is no evidence of a calculus.

Several observers have reported individual cases where gall-stones have been detected. Three cases were reported by Pfahler in 1911.[2] In 1913 Thurston Holland reported three cases, and called attention to the necessity for differentiating right renal calculi from biliary calculi.[3] This point alone justifies careful consideration of the subject. Gall-stones and cholecystitis have been observed röntgenographically in 20 out of 500 cases examined for gastro-intestinal lesions, and I believe that the systematic search for them by the method described in this article will reveal them in a much larger percentage of the cases examined. Before studying the röntgenographic indications of gall-stones and gall-bladder infection, the anatomy of this region should be noted. There are three possible locations for stones, viz., in the gall-bladder, the cystic duct, and the common duct. But such considerations, and also the frequency with which infection occurs with or without calculi, are questions not within the scope of this communication.

## INDIRECT EVIDENCE OF BILIARY CALCULI

The röntgenographic indications of gall-stones are direct or indirect. Direct evidence consists of a characteristic localized area of increased density, corresponding in size and shape with a calculus. Indirect evidence is afforded by the distortion of the adjacent hollow viscera by adhesions from an accompanying cholecystitis (Figs. 1 to 6). The indirect evidence will be considered first because of its greater importance. Moynihan states that it is now a matter of general acceptance that gall-stones are caused by infection.[4] If this is true, the indirect evidence is more valuable than the direct evidence, and indeed my experience has borne out this theory. In 30 per cent of the cases the lesion was detected solely by indirect evidence, and in 60 per cent of the cases the indirect evidence was a most important factor. I believe that the deformity of the cap and pars pylorica or the kinking and constriction of the hepatic flexure are stronger röntgenologic indications for surgical procedure than the presence of a calculus in the gall-bladder, without evidence of adhesions involving the hollow viscera. In such cases it is immaterial whether the infection is due to gall-stones, typhoid, or some unknown cause, or whether it has been of sufficiently long standing to allow the formation of calculi. In view of the numerous post-mortem discoveries of gall-stones, which did not cause symptoms sufficiently severe to justify surgical interference, it is obvious that the important point to determine in cases of unimpacted calculi is whether the stones are associated with cholecystitis extensive enough to cause symptoms. The accompanying adhesions manifest themselves in an

[2] Fortschr. a. d. Geb. d. Röntgenstrahlen., 1911, xvi, 335.

[3] Arch. Röntg. Ray, Lond., 1913, March, p. 374.

[4] "An address on gall-stones." Brit. M. J., 1913, No. 2714, 8.

[1] Since presenting this paper before the Atlantic County Medical Society on May 9th, Dr. Case, of Battle Creek, has published an article on gall-stones. Arch. Röntg. Ray, 1913, September.

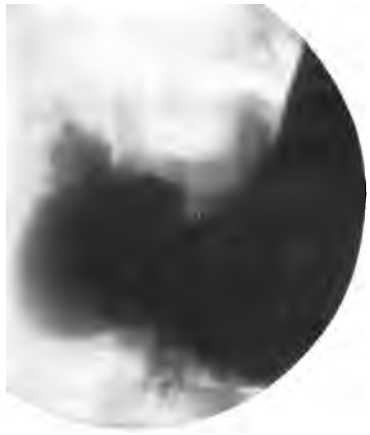


Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 1. Contraction of cap and pars pylorica by adhesions from cholecystitis with calculi invisible röntgenographically. Proven by surgery.

Fig. 3. Indentation in greater curvature, in which lay small, atrophic gall-bladder, containing calculus invisible röntgenographically. Proven by surgery.

Fig. 2. Absence of cap. Sphincter widened on lesser curvature. Cholecystitis with calculi invisible röntgenographically. Proven by surgery.

Fig. 4. Adhesions of cap and pars pylorica from cholecystitis. No calculus visible röntgenographically. Surgery imminent.

alteration of the lumen of the stomach, cap, or hepatic flexure of the colon.

### DIRECT EVIDENCE OF BILIARY CALCULI

Regarding direct evidence of gall-stones, two things must be considered: first, the detection of the calculus, and second, its differentiation from a renal calculus or some other calcareous body in this region, especially a calcified costal cartilage. The possibility of detection depends upon the percentage of mineral salts in the stone, or surrounding a cholesterin nucleus, upon the thickness and density of the surrounding tissue, and the penetration of the X-ray tube. A soft tube, a very short exposure, and the use of an intensifying screen will give a wealth of detail impossible to obtain by ordinary methods. In-

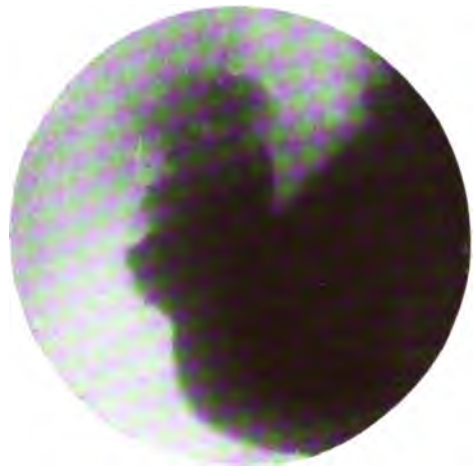


Fig. 5.

Fig. 6.

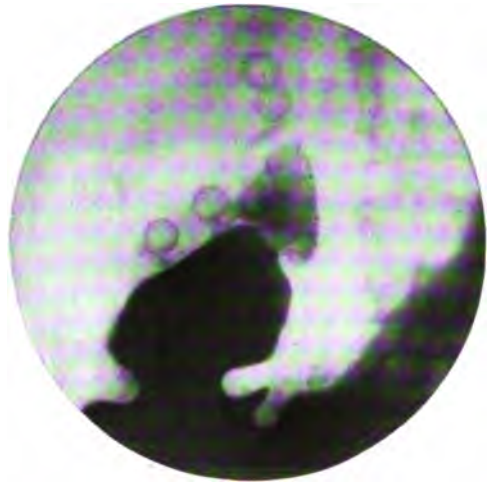


Fig. 7.

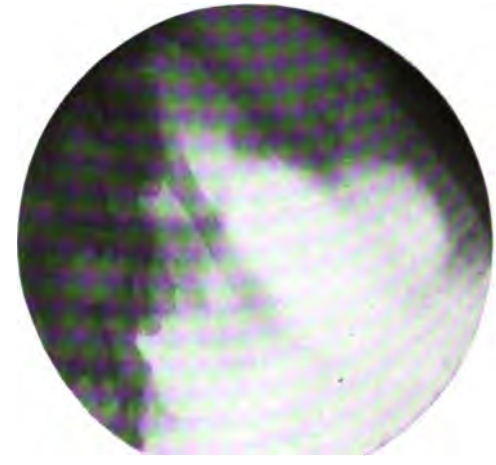


Fig. 8.

Fig. 5. Adhesions of cap, pyloric sphincter, and pars pylorica, from cholecystitis with a calculus visible röntgenographically (see Fig. 24). Proven by surgery.

Fig. 7. Pressure on terminal wave and cap by four gall-stones. Anterior view. Proven by surgery.

Fig. 6. Adhesions of cap from cholecystitis with a calculus visible röntgenographically.

Fig. 8. Same case as Fig. 7. Posterior view.

testinal content is often thus accentuated, and must not be mistaken for gall-stones. I have not found that the twisted position of the patient, claimed by Pfahler as an essential to the diagnosis of gall-stones, is of any particular advantage.

In some instances the calculus is shown so clearly that there is absolutely no doubt of its presence. In other cases it is so indistinct (Fig. 22) that it can be discovered only by making several röntgenograms, superimposing two or three of them, and examining them carefully against the sky. A stereoscopic study of two röntgenograms made with the tube in the same position or at slightly different angles sometimes aids very materially in the detection and interpretation of doubtful shadows. Occasionally an accumulation of

gas, or air artificially injected into the colon, will accentuate the stone in a remarkable manner. The organs surrounding it are relatively dense to the X-rays. There are stones which are no more opaque to the rays than the tissue which surrounds them, and there are others which are as opaque as the densest renal calculus. Between these two extremes are stones of all degrees of density. The technique above described will enable one to detect a relatively large percentage of biliary calculi.

*Differentiation between biliary and renal calculi.* The differential diagnosis of biliary calculi from right renal calculi is of great importance, and should be carefully made in every case presenting a stone in this region. The following points will aid in identification:

*First.* Biliary calculi show more distinctly and appear smaller when the plate is placed on the abdomen than when the plate is placed on the back. The opposite is true of renal calculi. When the biliary calculi is well back in the cystic duct, this variation of size is not so great as when it is in the gall-bladder. In such cases it is wise to place a small triangular marker on the abdominal wall and make two exposures, either on the same plate or on different plates, shifting the tube five inches between the exposures. Where two plates are used, match the shadows of the lead marker and measure the distance between the two shadows of the gall-stone. In order to determine with accuracy whether the shadow is nearer the anterior or posterior wall of the abdomen, repeat the above process with the plate posterior, and compare the distance between the shadows.

*To determine distance of calculus from abdominal wall.* By measuring the distances of the tube from the plate, and how far the tube is shifted between the exposures, the old principle of localizing foreign bodies described may be applied to find the distance of the calculus from the anterior abdominal wall.

Let $NO$ = plane of the two positions of the tube.
$C$ and $D$ = two positions of the tube.
$CD$ = 5″, distance between the positions of the tube.
$LM$ = plate, parallel to plane $NO$.
$X$ = shadow of marker on plate.
$A$ = shadow of stone when tube is at $D$.
$B$ = shadow of stone when tube is at $C$.
$EX$ = 20″.

To find $XY$:—

By measurement AB is found to be 1″

$\therefore AX = \frac{1}{2}''$.
$CD = 5''$.
$\therefore DE = 2\frac{1}{2}''$.

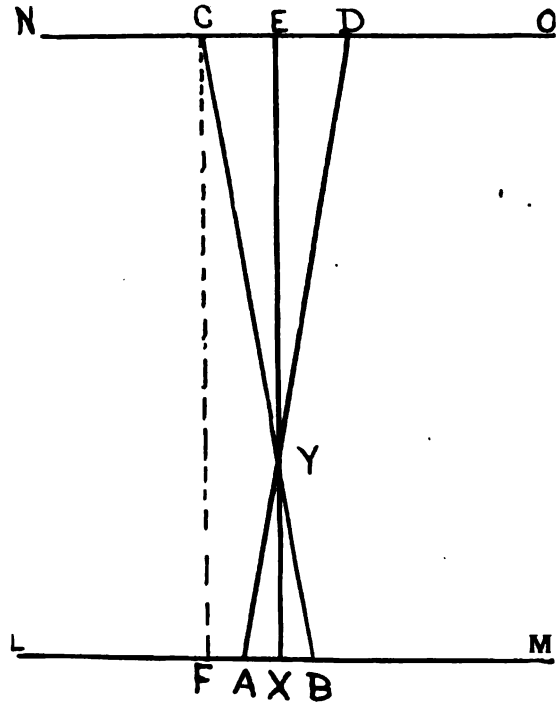
Lay off $FX$ equal to $EC$.

△ BFC and △ BXY are right-angled △'s. and have a common acute < BCF.

The sides of right-angled triangles having a common acute angle have the same ratio.

$\therefore$ FB : FC :: XB : XY, or 3″ : 20″ :: ½″ : $XY$
$XY = 3\frac{1}{3}''$.

Q. E. D.




*Second.* The second differential point is the ring-like shadow cast by a biliary calculus when there is a calcareous coating to a cholesterin nucleus. Renal calculi seldom if ever have this appearance.

*Third.* When three or more biliary calculi are present they are likely to have faceted surfaces, which are readily recognized röntgenographically. If more than one renal calculus is present one is usually larger than the others, and the group frequently has the appearance of a large, branching phosphatic calculus.

*Fourth.* Moving the tube from side to side alters the relation of a biliary calculus to the kidney, but it does not alter the relation of a renal calculus to the kidney.

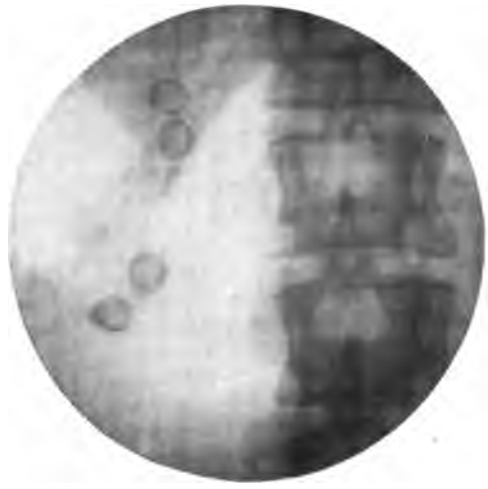


Fig. 9.

Fig. 10.

Fig. 11.

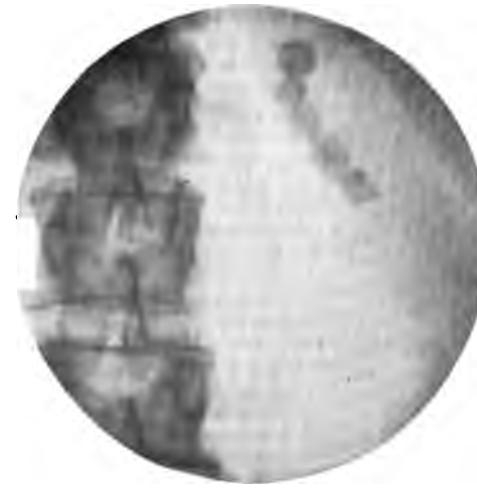


Fig. 12.

Fig. 9. Same case as Fig. 7. five days afterwards. Showing change in relative position of stones. Anterior view.
Fig. 10. Adhesions of cap and pars pylorica from cholecystitis with five calculi. Anterior view.
Fig. 11. Same case as Fig. 10. Anterior view.
Fig. 12. Same case as Fig. 10. Posterior view.

*Differentiation from duodenal ulcer.* Adhesions from cholecystitis so closely resemble adhesions and cicatricial contraction from prepyloric or post-pyloric (duodenal) ulcers that it is sometimes difficult to differentiate between them. But if the lesion is sufficiently extensive to indicate surgical interference, the differentiation is of more scientific interest than practical value. The points of differentiation between these conditions are as follows:

"Gall-bladder infection is usually more extensive. It involves the greater curvature and draws the stomach to the right, causing an angulation of the cap. The cap may be involved in the adhesions, but not more so than the pyloric end of the stomach. There is no evidence of a localized area of induration of the cap, and obstruction of its lumen is not as frequent as in cases of duodenal ulcer."

Fig. 13.

Fig. 14.

Fig. 15.

Fig. 16.

Fig. 13. Gall-stone, more dense near periphery than in center.

Fig. 15. Ring-like appearance of gall-stone, having center of cholesterin in a calcareous shell.

Fig. 14. Gall-stone, more dense near periphery than in center.

Fig. 16. Gall-stone, unusually dense to X-rays.

CASE 1. March 19, 1912. This is the most interesting of all the cases. The patient had typical symptoms of renal calculus, except blood in the urine, and was referred for an examination of the kidneys. The röntgenograms showed the region in question with sufficient distinctness for a negative diagnosis of renal, ureteral, and vesical calculus, and I advised a gastric examination. This revealed a permanently contracted cap and adhesions involving the extreme pyloric end of the stomach. I was unable to decide whether these adhesions were caused by duodenal ulcer or gall-bladder infection, but stated that surgical interference was justifiable, solely on the röntgenographic findings. Dr. Brewer, who operated, was rewarded for his confidence in the röntgenologic diagnosis by finding a cholecystitis with a number of small calculi not shown in the radiograph (Fig. 1).

CASE 2. December 21, 1910. There was a definite indirect evidence of adhesions involving the cap and pyloric end of the stomach, but there was no direct evidence of gall-stones. Some doubt existed as to whether the adhesions were caused by ulcer or gall-bladder infection, but there was no question as to

Fig. 17.

Fig. 18.

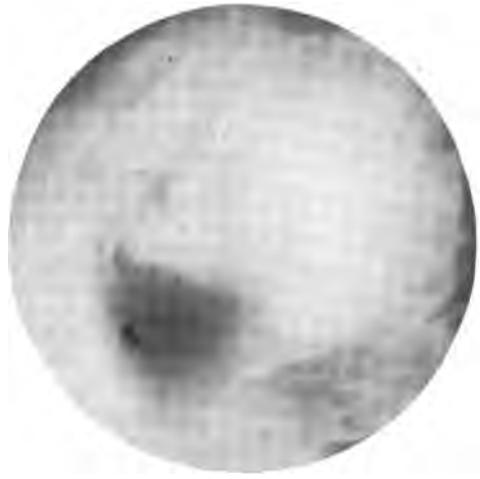


Fig. 19.

Fig. 20.

Fig. 17. Two small gall-stones, accentuated by an overlying accumulation of gas in colon.

Fig. 18. Large gall-stone, one inch in diameter.

Fig. 19. Cap so contracted by cholecystitis that only its base on left side is visible. Calculus in close proximity. Anterior view.

Fig. 20. Same case as Fig. 19. Lateral view showing how descending duodenum encircles calculus.

the advisability of surgical procedure. The lesion was found to be a cholecystitis with gall-stones, which were not shown röntgenographically (Fig. 2).

CASE 3. January 23, 1912. In this case there was no direct evidence of gall-stones, but there was a constant deep indentation on the greater curvature near the pylorus, resembling a small hour-glass stomach (Fig. 3). I thought that this lesion was caused by an old ulcer, and advised surgical procedure, which revealed a small calculus about the size of an almond in a contracted gall-bladder adherent to the gastric wall. This case has been frequently quoted as one in which I made an erroneous diagnosis. As a matter of fact, I recognized the location and extent of the lesion and stated that surgical procedure was indicated; and I maintain that recognition of the cause of the lesion is of more scientific interest than practical value.

CASE 4. January 10, 1913. The patient had had a perfectly typical attack of cholecystitis, with temperature, local tenderness, and a marked degree of jaundice. The röntgenograms showed a contracted cap and irregularities of the sphincter and lesser curvature of the pars pylorica, which constitute definite indirect evidence of adhesions involving this region (Fig. 4). The patient recovered from this

Fig 21.

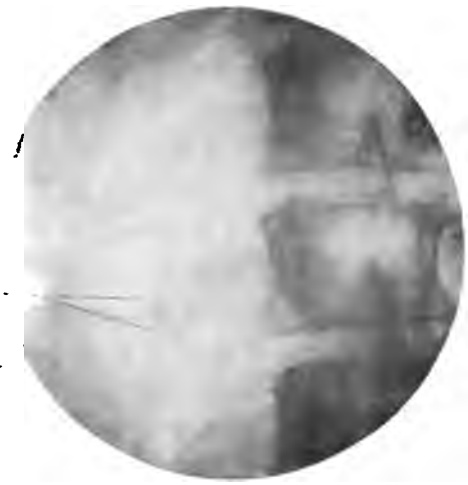


Fig. 22.

Fig. 23.

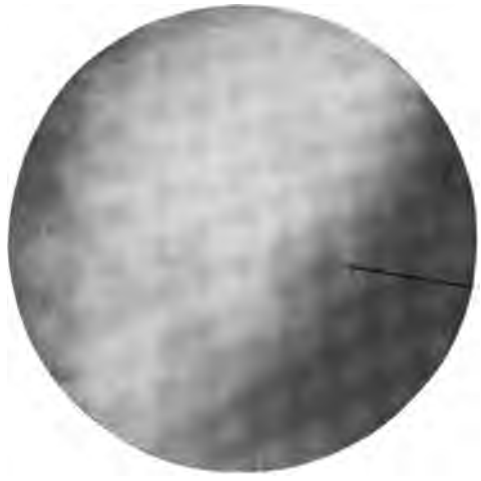


Fig. 24.

Fig. 21. Calcareous plaque in under surface of liver, diagnosed röntgenographically as a gall-stone. Proven by surgery.

Fig. 23. Gall-stone. No evidence of accompanying cholecystitis.

Fig. 22. Two indistinctly defined gall-stones. Proven by surgery.

Fig. 24. Large, faintly outlined gall-stone. Proven by surgery. For indirect evidence in this case see Fig. 5.

attack, and has not as yet consented to surgical procedure.

CASE 5. March 19, 1912. Patient shows both direct and indirect evidence of gall-stones, although the indirect is of more diagnostic importance than the direct evidence. An indistinct shadow of a large biliary calculus was present in all the radiographs (Figs. 5 and 24), but the adhesions caused by the cholecystitis were so extensive that they made me suspicious of carcinoma. The following is a quotation from the röntgenologic report.

"The absence of the duodenum, the contracted cap, the irregular worm-eaten appearance at the pylorus, and the absence of the pyloric sphincter indicate a lesion in this region which calls for surgical procedure. This lesion is probably adhesions from gall-bladder infection, probably with a calculus; but considering the irregular worm-eaten appearance of the pyloric end of the stomach, I do not feel justified in eliminating carcinomatous degeneration."

Six months later a note received from the patient's husband stated that she had not consulted a surgeon: "By following a strict diet for two months she is

greatly improved in health; while she is not considered permanently well, there is no longer any particular disturbance of the digestion or stomach."

Three months after this her physician wrote me that the patient had been seized with a sudden attack similar to the two previous attacks, which suggested gall-stone trouble very strongly. She was at once operated upon and a large gall-stone was found in the intestinal lumen, having worked through the adhesions from the gall-bladder and, at the time of this last attack, caused perforation of the bowel and acute septic peritonitis, resulting in the patient's death.

CASE 6. January 11, 1912. Both direct and indirect evidence of a biliary calculus were present, the stone resembling the one shown in Case 9: but it lies so far back in the cystic duct that there is not so much variation between its size in the anterior and posterior röntgenograms as in that case. As the characteristic ring-like appearance and the faceted surfaces were wanting, it was difficult to differentiate it from renal calculus. There were, however, indirect evidences of an accompanying cholecystitis with adhesions involving the cap and pylorus. The distended gall-bladder shows distinctly. The case was studied for a year, making two or three sets of röntgenograms, and during that time the adhesions involving the cap increased and caused a gastric retention. Surgical procedure revealed a gall-bladder corresponding in size and shape with the röntgenographic findings, the gall-stones, and the accompanying cholecystitis with adhesions (Fig. 6).

CASE 7. January 25, 1912. This case illustrates direct röntgenographic evidence of four gall-stones having the characteristic ring-like appearance. They show much clearer and appear smaller in the anterior than in the posterior röntgenogram. The clinical diagnosis prior to the röntgenographic examination was duodenal ulcer. Surgical procedure revealed a carcinoma of the appendix in addition to the gall-stones. Note the absence of adhesions, as evidenced by a normal cap and pyloric sphincter. By making a large series of röntgenograms we were able to obtain stereoscopic plates showing the manner in which the chain of calculi wrapped around the head of the pylorus (Figs. 7, 8 and 9).

CASE 8. January 13, 1911. A perfectly characteristic group of five calculi with faceted surfaces is shown in this case. The relation of these calculi to the junction of the cap and descending duodenum and their variation in size in the anterior and posterior radiographs are the pathognomonic radiographic indications of gall-stones (Figs. 10, 11 and 12). So far as I know this woman has not been operated, but there is no doubt of the diagnosis in this particular case.

CASE 9. January 11, 1910. The variation in size of a calculus in the anterior and posterior röntgenograms are shown in Figs. 13 and 14. This calculus did not have the characteristic ring-like appearance or faceted surface, but shifting of the tube between exposures altered its relation to the kidney. The patient was an unfavorable surgical risk, and no operation was performed, and no examination made for indirect evidence.

CASE 10. July 1, 1911. The characteristic ring-like appearance of a calculus, which is much more distinct in the anterior than in the posterior röntgenogram (Fig. 15), was present in this case.

CASE 11. December 11, 1905. This patient was examined for renal calculus. A distinct shadow was shown, slightly below the normal position of the kidney (Fig. 16). Operation failed to reveal a renal calculus, but a biliary calculus corresponding in size and shape with the röntgenographic finding was found.

CASE 12. May 13, 1913. The clinical history was one of acute attacks of pain, which had been diagnosed both as gall-stone and ptomaine poisoning. The indirect evidence showed a persistent contraction of the cap and an irregularity of the pyloric sphincter, believed to be either a spasm or adhesions. Subsequent plates, made for direct evidence, showed two clear-cut, well-defined shadows having the appearance of diplococci. They were visible in several plates, but happened to be very much accentuated in one of the plates presenting an accumulation of gas in the overlying gut (Fig. 17).

CASE 13. May 22, 1913. For two years the patient had had occasional attacks of severe pain and upward pressure in epigastrium, lasting for six and seven hours and leaving him sore and weak. He had lost thirty pounds in about a year. The röntgenograms showed direct evidence of a large calcified body anterior to the kidney and directly in the position of the gall-bladder (Fig. 18). The indirect evidence was pylorospasm and contraction of the cap, with a possibility of some adhesions. This is a recent case, and the patient is waiting until the summer is over before submitting himself to surgery.

CASE 14. May 15, 1913. The röntgenograms (Figs. 19 and 20) show both direct and indirect evidence. The cap is contracted and the pyloric sphincter irregular. Röntgenograms made in the lateral direction show that the descending duodenum encircles a gall-stone.

CASE 15. October 4, 1912. The direct and indirect evidence were at variance in this case (Fig. 21). The direct evidence showed a calculus, which I interpreted as a gall-stone after a most careful examination, including an application of all of the methods previously described. The indirect evidence showed no adhesions, as there was a perfectly normal stomach, pylorus, and cap, freely movable. Surgical procedure failed to reveal a biliary calculus, but there was a calculus in the under surface of the liver in close proximity to the gall-bladder, which was involved in slight adhesions, not, however, extending to the capsule in the liver. A thick band of the omentum was attached to the stump of an appendix previously removed.

CASE 16. February 26, 1913. The plates showed such slight ring-like shadows that they could be perceived only by viewing the plate against

the sky, and it was difficult to differentiate them from calcified costal cartilages (Fig. 22). We traced the outlines of two complete and several incomplete rings, and assumed that there were three or four calculi. Surgical procedure revealed only two calculi and a mass of thick tarry bile.

CASE 17. February 15, 1913, shows a calculus in exactly the proper relation to the duodenum and hepatic flexure for a gall-stone; but the patient was not a good surgical risk, and the symptoms were not sufficiently severe to indicate surgical procedure (Fig. 23).

CASE 18. March 24, 1911. A calcareous body was present in a series of röntgenograms. The clinical symptoms were those of gall-stones. Surgical procedure revealed a gall-stone; but there was also a calcified gland palpable in the field of operation, so it is impossible to state whether or not this really was a gall-stone.

CASE 19. February 26, 1912. The findings in this instance were almost identical with those of Case 18. Patient has not yet been operated on.

CASE 20. October 6, 1908. The plate illustrating this case was loaned to the surgeon and lost track of. The diagnosis was that of a gall-stone a little larger than a pea, one-half inch to the outer side of the median line, between the eleventh and twelfth ribs, behind and opposite the end of the sixth rib in front. The surgical findings confirmed the diagnosis.

Indirect evidence of gall-stones, or rather of an accompanying cholecystitis, as presented by adhesions involving the stomach, cap, duodenum, or hepatic flexure, is of more clinical value than the detection of the gall-stones themselves, because the adhesions represent an accompanying infection, requiring surgical intervention, while a gall-stone without infection may remain in the gall-bladder indefinitely without causing symptoms.

In conclusion, I would state that gall-stones may be detected sufficiently often to justify a röntgenographic search for them, but the absence of any direct evidence does not justify one in making a negative diagnosis, and should not prevent surgical intervention provided it is clearly indicated by the history.

Above all, I plea for a differential diagnosis between right renal calculi and gall-stones.

# A FURTHER STUDY OF PERICOLONIC MEMBRANES

By JOSEPH RILUS EASTMAN, M. D., Indianapolis

PERICOLONIC membranes, or pseudoperitoneums, present certain rather definite variations in structure, form, position, and relations. However, a correct classification of these formations can hardly be made with our present insufficient and disconnected data relating to their nature and origin. For the convenience of study these anomalous membranes may be divided as follows:

Group 1. Those peritoneal sheets or ribbons which, because of their position and attachments, seem to represent exaggerations of normal anatomic fusions, folds, or ligaments; for example:

(*a*) Those representing in an exaggerated or modified form.— The phrenocolic ligament of Toldt, the costocolic ligament, the hepatocolic ligament, etc.

(*b*) Those representing in an enlarged or modified form.— The bloodless fold of Treves.

(This is not always bloodless. It may present parallel or irregularly disposed blood-vessels).

(*c*) Those representing in amplified form.— The fold of Reid (genitomesenteric fold, or Lane's band).

(*d*) Those representing in amplified form.— The crescentric upfoldings of serosa, which divide the space lateral to the ascending and descending colon into peritoneal fossæ.

(*e*) Those representing in amplified form.— The attachments of the great omentum to the colon, occasionally resulting in fusion of the omental serosa to the peritoneum of the colon throughout its length.

Group 2. Pericolic membranes which correspond in form and position to anomalous peritoneal fusions or folds which appear frequently in the fœtus, but which are not constant and therefore not anatomic, as:

(*a*) The parietocolic fold of Jonnesco. This is believed by Eisendrath, Greensfelder, and Fallon to be a normal anatomic fold.

(*b*) The several so-called root folds.

(*c*) Nondescript peritoneal folds about the appendix and caput coli.

(*d*) Adhesions of the peritoneum of the colon to the upfolding peritoneum of its own mesentery (Robinson and Reid).

(*e*) A blanketing of the colon by the fused anterior and posterior peritoneal laminæ of the great omentum. The fat of the omentum is absent. It may be replaced by an abundance of parallel blood-vessels disposed, as a rule, transversely to the colon.

Group 3. Pericolic membranes occurring anywhere upon the large intestine, frequently over the splenic angle, which represent reaction to irritation of inflammatory or other character occurring in post-natal life.

(*a*) Membraniform adhesions occurring about the colon, the result of mild recurring peritonitis, often secondary to chronic colitis (Virchow and Gerster). These are similar to the pseudoperitoneums seen occasionally upon the broad ligament, the uterine fundus, and the uterine adnexæ. I have produced such formations in rabbits by prolonged administration of morphine and by anal ligation inducing coprostasis.

(*b*) Changes in the peritoneum of the colon due to pathology of the circulation, as hyperæmia or varicosities (Hertzler and Cuneo).

All of the varieties of pericolic membranes enumerated above have been observed in the fœtus, and whatever the fundamental processes of pathology which cause these formations may be, it seems reasonably certain that those processes are often active in fœtal life and that all forms of pericolic membranes, with the possible exception of those embraced in Group 3, can be traced to fœtal fusion.

The failure to observe membranous pericolitis in young children has been interpreted with some reason as evidence showing that such membranes cannot be associated in any way with fœtal peritoneal anomalies, but on the other hand must, in practically all cases,

be consequent upon certain agencies which do not become operative before maturity.

It is true that membranous pericolitis has been observed much less frequently in children than in adults, but there are several quite obvious reasons for this. Abdominal operations for all causes are much less frequent in children than in adults. The simple controlled diet of children, their free indulgence in exercise, and other healthful habits of living protect them in some measure from the clinical process which pericolic membranes induce. If the clinical process be established in a child, neurasthenia, one of the conspicuous symptoms of pericolitis, is not always a part of it, therefore the condition may go undiagnosticated and unoperated. It is a mistake, however, to assume that membranous pericolitis does not occur in young children.

With a view to considering the collective experience of men who have large opportunities for observation in this field, and thus perhaps to shed some light upon the question of the incidence of pseudoperitoneums in children, as well as upon the subject of their nature and origin, communications of inquiry were addressed to representative teachers of surgery in this and other countries. Upon examination of the replies it appears that pericolic membranes have been observed during abdominal operations upon children by nearly one-half of the surgeons addressed. By some of those who replied in the affirmative, the pericolic membranes were assumed to represent congenital sheets or bands as described by C. H. Mayo and Flint. By others the membrane-forming pericolitis was looked upon as a condition secondary to colitis with subsequent mild repeated peritonitis, in the sense of Gerster and Pilcher. Others believe the membrane to be due to a combination of the causative factors mentioned above. However, all of the following have found anomalous pericolic membranes in children of twelve years of age, or younger: Roux, Stiles, Czerny, Albrecht, Lane, Willy Meyer, C. H. Mayo, M. L. Harris, Flint, Binnie, McArthur, Gerster, Greensfelder, Hill, Summers, Knott, Coffey, Connell, Porter, Eisendrath, Hertzler, Finney, Sherman, Seelig, Collins, Cheever, Freeman, and Haines.

Often in young persons Professor Roux has observed a veil of new and almost free peritoneum containing young blood-vessels disposed transversely. The symptoms in these children were like those of chronic appendicitis. Roux observed these membranes at various levels upon the ascending colon. Stiles of Edinburgh has observed pericolic membranes in children from a few years of age upwards. Czerny has frequently seen anomalous peritoneal membranes upon the colon in children. M. L. Harris observed a typical Jackson's parietocolic membrane in a boy of twelve, and Willy Meyer, C. H. Mayo, D. N. Eisendrath and L. L. McArthur have frequently observed Jackson's membrane in young children. Flint observed the membrane in children eight, ten, twelve and sixteen years of age and believes that they occur in the same incidence in children as in adults, the reason that they are not more frequently seen being due to the fact that we operate upon adults ten times more frequently than upon children.

Notwithstanding the reports of the surgeons mentioned above, which give instructive evidence as to the not infrequent occurrence of membranous pericolitis in children, it may be said that, before conclusions are drawn as to the incidence of Jackson's membrane in children, such clinical evidence should be supported by autopsy reports covering many examinations of the peritoneum in children. Flint supplies such supporting testimony received by him from Dr. Samuel Harvey, instructor of pathology in Columbia University. Harvey did 108 autopsies on infants from one to two years of age. In 16.6 per cent of the cases he found membranes of the parietocolic type. In 13.9 per cent of cases he found a membrane covering the caput coli. Lane's band, or Reid's genitomesenteric fold was found in 9.3 per cent of cases. Flint says that the work of Harvey supplies the missing link between the fœtal structures and the adult veils, and confirms absolutely their congenital origin, and adds that he has no reason to change his views as expressed in his paper published in the *Johns Hopkins Bulletin* for October, 1912, in which he stated his conclusion that pericolic membranes of adults are

Fig. 1. In center of picture a pericolonic membraniform adhesion. Induced experimentally in a rabbit by anal ligation.

instances where the secondary fusions of the peritoneum in embryonic life are more extensive than we are usually accustomed to consider the norm.

In 500 autopsies on children under six years of age Albrecht of Vienna found pericæcal membranes present in about 15 per cent of the cases (Fallon[1]).

Van Buren Knott reports the cases of two infants, one year old, operated for intussusception, who had well-developed Jackson's membranes.

Eisendrath has found pericolic membranes in children of all ages from four to sixteen, and believes them to be of frequent occurrence in children. He believes, moreover, that such pseudoperitoneums are fœtal peritoneal folds which under some circumstances, like the normal pleura or any other serous membrane, become infected and thickened, and then cause kinking and other forms of chronic obstruction.

C. H. Mayo, Harold Stiles, Sir William Bennett, and others express the belief that membranous pericolitis must be of rather infrequent occurrence in young children, and this view is borne out by the experience of many surgeons who, despite very great opportunities for observation, have not seen a case of Jackson's membrane in a child. Some of them (Tinker, Schwyzer, and others) look upon uncomplicated pericolic membranes as quite harmless deviations from the normal and, having no special interest in them, do not seek them as a routine practice. Nevertheless, the negative reports as to the incidence of membranous pericolitis in children are not without meaning in view of the quality and volume of experience represented by the following, who have not observed pericolic membranes in young children: von Eiselsberg, Maylard, Handley, D'Arcy Power, Pierce Gould, Kellock, Wilms, Verhoogen, Pilcher, Crile, Walker, Bovée, Peterson, Montgomery, Morris, Murphy, Jackson, Ries, Deaver, Rodman, McMurtry, Kanavel, F. H. Martin, Bartlett, J. S. Horsley, Littig, A. T. Mann, A. A. Law, Grant, Moore.

It should be remembered, however, that these men are surgeons and, therefore, would as a rule observe only such pericolonic membranes as are associated with clinical manifestations.

Several others who replied in the negative are gynecologists of large experience, but who are called upon very rarely to make abdominal operations in young children. Verhoogen, of Brussels, speaks of the possibility of his having overlooked pericolic membranes in childhood for the reason that his attention has never been directed to them. Among those who had not encountered anomalous pericolic membranes in children, three remarked that they were doubtless present in childhood, but since it is the infective accidents of later life which bring them into the clinical field, they escape observation in children.

A few of those who do not approve the hypothesis of embryonal origin of any variety of pericolic membrane report the frequent

[1] Boston M. & S. J., 1913, Oct. 23.

finding of Jackson's anomalous membrane in association with cæcum mobile. However, this combination in itself furnishes evidence suggesting a fœtal origin, for in the mobile cæcum swinging as it does through an abnormally large arc, we have an instance in which a secondary fusion between the cæcum and the mural peritoneum may be drawn out readily in a degree and form quite beyond the norm.

Although it necessitates a digression from the subject-matter of this paper, it may not be amiss to call attention to another phenomenon which suggests a fœtal origin of pericolic membranes about the caput coli. It is the almost constant observation that when during operation for removal of the appendix vermiformis the uninflamed appendix is found buried under a pericolic membrane of the exaggerated Treves' bloodless fold variety, such a veiled and pocketed appendix is almost always of fœtal type — that is, long and very slender. Such membrane-covered appendices are often not more than two millimeters in diameter and are rarely of a diameter exceeding three millimeters and show many evidences of interrupted development.

Almost a score of surgeons, including Stiles, Mayo, Verhoogen, Vander Veer, Connell, Eisendrath, Summers, and McArthur, answered the inquiry as to the origin of the membranes by stating their belief that they are developed in the fœtal period.

A somewhat smaller number, including Handley, Czerny, Crile, and Gerster, incline to the belief that membraniform pericolitis is the consequence of a colitis spreading through to the peritoneal surface.

A third group, including Pilcher, Morris, Finney, Jackson, Hill, Kanavel, Ries, and Horsley, believe pericolic membranes, as seen in the adult, to be in part congenital and in part acquired as a result of extension of inflammatory processes within the lumen.

Gerster, recognizing the part which persisting fœtal folds may have in adult intestinal pathology, makes a sharp distinction between membraniform anomalies representing developmental accidents and those essentially different membranes which are consequent upon colitis. He has frequently found the two varieties in association, and believes that

Fig. 2. Fusion between colon at splenic angle and omental serosa producing a pericolonic membrane. Result of anal ligation in a rabbit.

the congenital bands frequently represent the starting point of similar pathologic formations of adult life.

Several surgeons in their answers volunteer the suggestion that pericolic membranes about the caput coli are more often the cause of appendicitis than the effect, torsion, angulation, or compression of the appendix by the membrane so interfering with drainage as to lead to inflammation.

There would have been, without much doubt, less divergence of opinion as to the absolute and relative frequency of pericolic membranes in children if the questions and answers had been formulated with a definite understanding as to what really constitutes a Jackson's veil as distinguished from a membranous adhesion.

Anomalous peritoneal folds, wherever and whenever found, notwithstanding their variations in macroscopic and microscopic appear-

ance, are with respect to their nature and origin probably quite closely related. The frequency of anomalous pericolic folds in the fœtus and the fact of their very common presence in young children indicate that, whatever the fundamental pathologic process which causes them may be, this process frequently becomes operative in embryonal life.

Concerning pericolic membranes which arise during adult life it seems fair to suspect, in view of experimental evidence, that they result, for the most part, from the adhesions of a plastic peritonitis, usually of mild chronic character. Membranes thus formed are usually thinner and less vascular than those which date from the fœtal period, and, as remarked by Lardenois,[1] do not resemble embryonal peritoneum.

The writer has experimentally produced such pericolic membranes in rabbits by inducing a low grade plastic peritonitis. The mild adhesive peritonitis occurred as the result of the plugging of the large intestine with its own contents. Extreme coprostasis was induced by intermittent ligation of the anus and administration of morphine over a period varying from two weeks to three months. Care was taken not to confuse the normal long-flowing mesenteries of the rabbits with membraniform adhesions. As in other quadrupeds the mesenteries of the rabbit are luxuriantly developed, a single mesentery in some cases enveloping and supporting several intestines. The membranous adhesions which were attributed to the artificially induced plastic peritonitis occurred in cases in which the intestines were held together over extensive areas by plastic lymph. The membranes were brought to view by separating the intestines at the site of imperfectly organized adhesions.

Such pericolic membranes are not different in histology and origin from similar membranes about the uterus and uterine adnexæ, all representing reactions of the peritoneum to irritation.

Of the types of pericolic membranes produced experimentally in rabbits as mentioned above, one of the most common was that represented by a blanketing of the splenic angle with the fused anterior and posterior laminæ of the great omentum, suggesting an exaggeration of the phrenocolic ligament of Toldt.

Hertzler and Cuneo attribute those vascular pericolic membranes, with vessels coursing horizontal to each other in the line of the long axis of the ascending colon or transversely to it, to pathology of the circulation. Cuneo believes that the blood-vessels produce the membrane. It is, however, no contradiction of the position of these writers to assume that the hyperæmia or varicosity spoken of by them, as well as the insufficiency of the muscular coat of the intestine mentioned by Tuffier, suggest reactions of the peritoneum to irritation. Lenormant and Oberlin[1] emphasize the importance of the relation of adhesion in plastic peritonitis to pericolic membranes. They make a distinction, however, between plastic membranous adhesions of adult life and those of embryonal origin.

Adhesions in fœtal life probably bear the same relation to pericolic membranes as do adhesions of the adult. It is probable that the true Jackson's membrane appearing upon the right half of the colon is usually an affair of fœtal development, the result of accidents of cæcal descent and torsion. On the other hand, membraniform adhesions of post-natal life, in the sense of Virchow, Gerster, and Pilcher, may appear anywhere upon the large intestine, the most frequent site probably being the splenic angle.

In conclusion it may be said that it seems probable that several factors enter into the causation of pericolic membranes; that the several factors are closely related; that fusion or adhesion as a result of reaction to irritation, hyperæmia, or developmental accidents in the prenatal or post-natal period may lead to anomalous peritoneal formation; that in the fœtal period of development abnormal fusions occur with notable frequency and with interesting constancy as to location and form; that pericolic membranes unassociated with chronic or acute colitis or peritonitis are of fœtal origin; and further that in a great measure the same pathologic processes underlie pericolic membrane formation at all ages.

[1] J. de Chir., 1913.

[1] Rev. de gynéc. et de chir. abdom. Par., 1913, Sept.

# DEPARTMENT OF TECHNIQUE

## FIXATION OF FRACTURES BY MEANS OF AUTOGENOUS INTRAMEDULLARY BONE SPLINTS

By CHARLES E. PHILLIPS, M. D., Cristobal, Canal Zone, Panama
Chief of Surgical Clinic, Colon Hospital

AT the present time there is probably no subject that has undergone the changes or made the advancement that we find taking place in the domain of bone surgery.

We have seen the gradual evolution of the open treatment of fractures from its inception where the splendid results of a few pioneers encouraged others to emulate their success. Possibly through inferior technique or judgment in handling their cases the results were unsatisfactory. This led to open objection by some, disagreement and doubt by others, as to the advisability of the open treatment of fractures. Such remained the status of the open treatment of fractures until the results of the successful were multiplied and the mistakes of the unsuccessful were pointed out.

We are indebted principally to Mr. Lane for a technique which, if followed, seemed to insure success. Since the advent of his methods of operation we have seen the operative treatment of fractures increase enormously and it is still increasing.

But while the use of the Lane plate is becoming more frequent, I believe the time is soon coming when we shall lay aside the Lane plate, the ivory pegs, and various other articles made use of by surgeons for the fixation of fractures and shall fix them without the use of foreign substances, i.e., by means of autogenous bone splints or transplants.

I shall consider only the use of the autogenous bone splints in these remarks because I am of the opinion the use of homogenous bone splints—those taken from another human body — kept in cold storage or otherwise is attended with so many difficulties of possible blood reactions, diseased conditions, or infections as to render its use undesirable at least for some time to come. In using a foreign bone it seems we are exposing the patient to a lot of unnecessary dangers to procure an inferior article. I believe at the present state of our knowledge all will agree that the autogenous bone graft is far superior to that taken from another individual.

Any one observing the effects of burying nonabsorbable substances in the human body has probably been struck first by the tolerance of the tissues to the foreign substance and secondly by the disturbance or untoward remote effects arising from a foreign substance which has remained quiescent in the tissues for a long time. A foreign body, Lane plate, silver wire, bone-peg, or other favored substance is used in the fixation of a fracture. The wound heals per primum. The patient is discharged well. We note a perfect result and are satisfied.

Perhaps a year elapses, perhaps more, when that patient comes back, or goes to some one else, complaining of pain at the site of the old break. A careful skiagraph shows a chronic osteitis which may subside with rest and immobilization to reappear later, or it may persist until the foreign substance has been removed, and the process may go on after the removal of the foreign body.

The fixation apparatus may be tolerated without reaction by the tissues for many years when suddenly a slightly lowered resistance in the general condition of the patient furnishes the opportunity for an endogenous infection. Certain areas of the human body are by structure and vascular supply more susceptible to infection than other portions and such a condition we create in the contacting tissues by the insertion of a nonabsorbable substance. In this position, as in the natural vulnerable areas of the human organism, infection does not necessarily follow in a certain length of time or ever for that matter, but as long as the foreign substance is embedded, there is just as surely a point of lowered resistance and potential trouble and may become a nidus for infection at any future time. For this reason the results of Mr. Lane, with his incomparable technique, have been so excellent. He recognizes the susceptibility of the traumatized tissues to any infection and averts trouble by a perfect aseptic technique.

The difference between the old operation and

Fig. 1. 1. Ratchet brace. 2. Vise. 3. Hollow auger. 4. Twist drill bits. 5. Board on which vise is fastened.

the new does not lie in the primary operation. The damage to the tissues has been done when the fracture occurred. The operation is the same in all cases and presupposes a perfect aseptic technique. Primary liability to infection is the same in both cases, but the difference does lie in the late manifestations of trouble arising from a buried foreign substance on one hand and the autogenous bone splint on the other hand soon becoming an active, living, integral part of the bone in which it is inserted. It requires no removal; subjects the patient to but one operation; and does not exist as a menace in subsequent years.

There are several reasons why autogenous bone splints have not been more widely used in the routine fixation of fractures. Probably first and foremost among these has been the paucity of suitable instruments. Without suitable instruments the operation becomes impossible.

The operation of bone-plating achieved no popularity with the profession until suitable instruments were devised, thereby rendering the operation comparatively easy and a perfect asepsis possible. When the technique of fixation of fractures by autogenous intramedullary bone splints becomes perfected to such a state it can be performed with almost as little trouble as plating, and with as rigid an aseptic technique, I am firmly of the opinion the metallic plates, etc., will deservedly give way as the method of choice in the open fixation of fractures. Suitable instruments in the ordinary surgeon's armamentarium for this class of work are exceedingly rare. Outside of Dr. Murphy's most excellent medullary reamers and retractor-guide, the special instruments devised for this work are very few and, as far as I can discern, very unsatisfactory.

With an idea of what these instruments should be I looked about and found a very satisfactory embodiment of my ideas in the tools of the carpenter and carriage maker. I believe that any one with a fair amount of mechanical ingenuity and with sufficient practice on the cadaver, or on other bone, to familiarize themselves thoroughly with adjustment and use these instruments, will find them very satisfactory. They consist of:

(*a*) Ratchet brace, similar to those used by carpenters or wood workers;

(*b*) Twist drill-bits, about eight or ten in number in graded sizes from about one-fourth inch in diameter to five-eighths inch in diameter;

(*c*) One small vise with clamp to fasten to board — the vise is a small affair weighing about one and one-half to two pounds;

(*d*) One adjustable hollow auger, such as is used by carriage makers for fashioning the ends of spokes that go into the felloe. It can be adjusted to cut tenons any size from one-fourth inch to one inch in diameter and upward.

(*e*) A piece of ordinary board of suitable length to be placed in sterilizer and of proper thickness for the attachment of the clamp of the vise.

The technique is very simple. For instance, if it is desired to insert a transplant in a simple fracture of the tibia: A linear incision is made over the tibia, the ends elevated above the skin one at a time, a drill bit selected which will just clean the medulla out to solid bone. This drill bit is put in the brace and the ratchet on the brace turned so the drill will turn in the right direction. The handle of the brace cannot be turned entirely around on account of the proximity of the leg, hence the necessity of the ratchet brace. The medulla is reamed for such distance of one or two inches as is necessary to secure a firm socket for the transplant. The end is then dropped and the other end treated in the same way. The size of the bit is then noted and a transplant cut from the crest of the opposite

tibia by means of a drill and chisel, cutting a little larger than the transplant required. The vise is fixed to the board and this held firmly on the instrument table by an assistant. The transplant is picked up by means of forceps and one end of it is grasped by the jaws of the vise. The hollow auger is then put in the brace and by means of the screw is adjusted to cut a tenon the exact size of the drill bit used in excavating the medulla. The size of the tenon is shown by the gauge on the face of the hollow auger. The length of the tenon should equal the combined depth of both of the holes reamed. With the bone held in the vise, in a few moments the transplant can be converted into a perfectly smooth, true, living bone tenon of exactly the right size to fit the hole in the medulla. In the ordinary fixation of a simple fracture a long transplant is not necessary nor desirable. A transplant of one and one-half or two inches, provided it fits accurately, is sufficiently long to hold in perfect position a fracture of femur, humerus, etc.

If a long transplant is required— more than four inches— it will be necessary to true up one end of the transplant as far as the hollow auger will cut (about four inches), then reverse the bone in the vise and true up the other end, taking care that the boring from one end meets accurately the boring from the other end. The bone is then taken by means of forceps and transferred to the place prepared for it, where it will fit perfectly if the instruments have been properly adjusted.

The Lane technique may be carried out in using these instruments with the greatest ease.

If it is desired to insert a transplant between the ends of a bone, a portion having been destroyed by accident or disease: For illustration, say there is a six-inch piece lacking in a tibia. To repair the defect a half-inch hole is reamed in the medullary canal of the upper fragment to a depth of, say, two inches. Another hole of the same diameter and three-fourths inch in depth is made in the lower fragment. A transplant is cut from the opposite tibia eight and three-fourths inches in length by about five-eighths in diameter. Placing the transplant in the vise and with the hollow auger fastened in the brace and adjusted to cut a tenon one-half inch in diameter and with the sliding gauge on side set for two inches in length, the upper end is completed. Reversing the bone in the vise and adjusting the gauge of length to three-fourths of an inch, the opposite end is completed.

Fig. 2. Hollow auger showing face with scale of diameters and screws to adjust diameter and length of tenon cut.

This leaves the large part of the transplant six inches in length — just sufficient to fill in the gap. The upper or long tenon is inserted into the hole prepared for it. It has no lateral motion, neither can it push up farther into the medulla than the two inches cut by the hollow auger. Then by making a moderate amount of traction the lower end can be pushed into the hole prepared for it. The lower tenon has purposely been made shorter to facilitate insertion.

When in place the leg will be found to have the exact length required and will be rigid.

Regeneration of the transplant is undoubtedly greatly facilitated by extensive accurate apposition to living bone cells and by the immovable fixation in such a position.

The time required to perform the operation of fixation of simple fractures by means of the autogenous graft nearly approaches that required for Lane plating. With the old method of preparing a transplant, when to secure a fit was more or less accident, coupled with the design, there is no comparison.

These instruments can all be boiled to insure absolute sterility; can be procured from any dealer in carpenter tools, and at a trifling cost.

In conclusion I desire to thank Lieutenant Col J. L. Phillips, Assistant Chief Sanitary Officer, for permission to publish this paper.

# INDIRECT TRANSFUSION OF BLOOD

By ANDRE CROTTI, M. D., Columbus, Ohio
Surgeon to Grant Hospital and Children's Hospital

ALTHOUGH thoroughly familiar with the technique of vascular surgery, I have always felt that the direct transfusion of blood by arteriovenous anastomosis was a very delicate operation, and very often unsuccessful. Everyone who is familiar with that kind of work knows how difficult it is to anastomose properly, for instance, the small vein of a child with the large radial artery of a man, and even when the anastomosis has been successfully performed, there is no way of telling if the arterial blood is running into the vein, and if it does, how much has been transfused. The operation is a long and difficult one. The same objections are true for the other methods of transfusion, as for instance, when performed with small glass tubes prepared with alboline or paraffin. Therefore, I sought to find a simpler method which might be just as efficient, if not more, and become more popular on account of its simplicity. It is called indirect transfusion of blood.

With Dr. Shilling, pathologist at Grant Hospital, I made a series of experiments on dogs in order to determine the coagulation time of the blood, when withdrawn, first, in a sterile, dry glass; second, in a glass boiled in normal salt solution; third, in a glass boiled in alboline. The average coagulation time was from five to eight minutes for blood withdrawn in a dry, sterile glass, and from seven to twelve minutes for blood withdrawn in a glass boiled in salt solution or in alboline. Therefore, I thought there would be plenty of time to withdraw blood with a syringe from a vein and reinject it into another one without running any danger of coagulation. This was indeed successfully demonstrated in each of our numerous experiments. We were able, provided that certain rules were followed, to withdraw several hundreds of cubic centimeters of blood from a vein of a dog and to reinject it into the vein of another without a particle of trouble, and I was able to demonstrate the efficacy of the method in two cases which I herewith report.

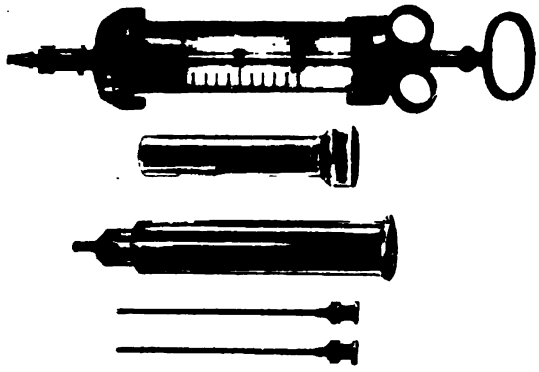
Case 1. The patient, Mr. G. H., 16 years old, was referred to me by Dr. McKenzie, of Lancaster, Ohio, on April 2, 1913. In October, 1912, patient noticed a lump in his right cheek causing shooting pain in the right temporal fossa. No trouble in chewing or swallowing. No soreness. An unsuccessful attempt to remove this tumor was made by another surgeon in January, 1913.

When I saw the patient in April, I found in the right cheek below the zygomatic bone, a tumor located outside of the buccinator muscle. It was about the size of a walnut, had sharp limits, was lobulated, firm in consistency, painless to pressure and not adherent to the skin. A bidigital examination, one finger in the mouth and the other outside, showed that the tumor had an upward prolongation which disappeared under the zygomatic bone. The latter one on the right side was more prominent than on the left side. There seemed to be a slight paretic condition in the region of the facial nerve, although there was no paralysis. Tonsils and adenoids were very much enlarged. The right posterior choana was filled with a mass, red-bluish in color and bleeding extremely easily when touched with an instrument. I made the diagnosis of myxofibromatous polypus and concluded that this tumor in the cheek was only an extension of this same tumor passing through the pterygomaxillary opening. I referred this case to Dr. John Edwin Brown, eye and nose specialist, who very successfully and skillfully removed the polypus by the canine fossa route. The operation was extremely bloody, difficult, and lasted an hour. At the end of the operation the patient was more or less exsanguinated. Pupils were dilated; pulse could not be felt. Patient seemed to be in imminent danger of death. Very quickly I made an indirect transfusion to the patient of one and one-half ounces of venous blood taken from the father and injected a quart of salt solution intravenously. The blood transfusion did not last more than five minutes. The boy recuperated gradually, his pulse, although extremely rapid, became palpable; three hours after, his hæmoglobin was 55 per cent. In the hurry, unfortunately, hæmoglobin had not been taken before transfusion. Gradually the boy's strength came back and he made an uneventful recovery. The microscopical examination confirmed the diagnosis of myxofibroma.

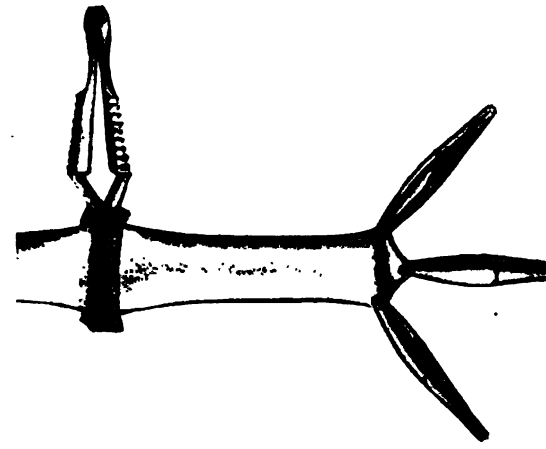
Case 2. Mrs. M. P., 30 years of age, was referred to me by Dr. H. M. Beebe, Sidney, Ohio. The patient had a goiter, examination of which showed it to involve both lobes and the isthmus of the thyroid, the lower pole of the right lobe dipping behind the clavicle and the sternum. In addition to this intrathoracic character of the goiter, the patient showed some symptoms of thyroid intoxication, so she entered the hospital, was put to bed and a preparatory treatment of several days carried out.

She came to operation in apparently good condition, although the pulse was still rapid. Morphine-scopolamine, ether anæsthetic. The right upper pole was ligated and the right lobe and the isthmus resected. The amount of hæmorrhage was only moderate but the operation offered some difficulty on account of the intrathoracic portion of the goiter. The patient woke up on the operating table, her pulse at this time being rapid and weak, but her color was good and no signs of collapse apparent. Five or six hours after, her heart suddenly collapsed and despite all treatment, including an indirect transfusion of 75 ccm. of blood from the husband, the patient died. Respiration continued for some time after the heart had ceased to beat. This case was a typical case of heart failure.

The technique of the indirect transfusion in this case was identical to that used in Case 1, but



Figs. 1 and 2.



Mosquito forceps and artery clamp applied to vein.

the indications for the procedure in Case 1 became apparent in the operating room where it could be carried out without any appreciable loss of time; while in Case 2 the collapse occurred several hours after the operation, in the patient's room, and some considerable time was necessary to prepare, sterilize, etc., before proceeding. The patient in the second case was beyond aid, although the actual elapsed time for the indirect transfusion itself was slightly more than five minutes.

*Technique.* Iodine preparation of the skin of the donor. Local anæsthesia with novacaine, one per cent. Incision of the skin three or four ccm. long in the angle of the elbow. The cephalic vein is dissected out and cut at the upper end

of the incision. The proximal end is ligated with catgut. To the distal end three small mosquito forceps are applied at equal distance one from the other in order to maintain the lumen of the vein open. (See illustration.) A small artery clamp applied a few centimeters below prevents the blood from leaking.

The same operation is performed on the recipient with the difference that the vein is ligated at the lower end of the incision.

A blunt needle which has been adapted to a syringe is introduced into the vein of the donor, in the opposite direction of the blood current; blood is aspirated into the syringe, and reinjected into the vein of the recipient, in the same direction as the blood current.

The transfusion can be repeated as often as is deemed necessary without coagulation, provided needle and syringe are freshly washed each time in a warm normal salt solution. The best plan is to have two needles and two syringes and to have one set washed by an assistant while the other is in use. When transfusion is terminated, the veins are ligated and the skin incision closed. By this method any amount of blood can be transfused safely from one patient to another and the exact amount of blood transfused is known. The fact that the blood is venous seems to be without importance. My first case would seem to prove that it is not necessary to transfuse large quantities of blood to save a patient. However, it can be done if deemed necessary. The technique is simplicity itself, and can be used by anyone. A few bubbles of air are of no importance.

# THE MATHEMATICAL CALCULATION OF PROGNOSIS IN FRACTURES AT THE ANKLE AND WRIST

By E. H. SKINNER, M. D., Kansas City, Missouri

THE prolific use of the X-ray has forced surgical attention to the anatomical reduction of fractures. Anatomical reduction is a worthy ambition, but our appreciation of functional reduction has been obtunded thereby. I desire to show you that less attention to fragments need be displayed if the joint surfaces are in correct relation and the lines of weight-bearing force are functionally satisfactory. In an attempt to reduce to mathematical exactness the relation of certain weight-bearing surfaces, I present for your consideration certain studies upon two of the commonest joint injuries; i.e., fractures at the ankle and fractures at the wrist. My work upon the shoulder and hip is not as yet crystallized into simple estimations.

These studies have been pursued with the idea of bringing this method of prognosis within the reach of the physician outside of the larger cities and where the X-ray apparatus may be of small capacity. The mathematical diagrams herewith presented may be applied to any such negative if the directions regarding the position of the parts are followed.

## FRACTURES AT THE ANKLE

*Axiom.— The functional result of an ankle fracture depends upon the proper reduction of the astragalus so that the line of weight-bearing force which passes through the center of the tibia also passes through the astragalus at its center.*

*Directions for exposures of the ankle.* The illustrations which serve to amplify this article are reductions from 5 x 7 inch plates. The X-ray exposures are always made with the leg resting upon the long surface of a right angle frame, and the foot is supported by an Esmarch bandage or heavy rubber bands against the right-angled foot piece. The X-ray tube is centered, in the adult, one inch above the center of a line connecting the external and internal malleolus. An exposure with even the crudest apparatus will give a nega-

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 1. Normal ankle-joint taken in the anteroposterior position and showing that a line drawn through the center of the tibial shaft will pass through the center of the astragalus. Note the normal apposition of the astragalus under the tibia.

Fig. 2. An old fracture of the ankle, with extreme displacement of the astragalus. Note the relation of the astragalus to the line through the tibia. The weight of the body in walking is carried to the foot by the shaft of the tibia, and if the astragalus is not centered under the tibia, there is more or less pain and discomfort in walking.

Fig. 3. An old fracture of the ankle. It will be noted that the ankle mortise is broader than normal, and the astragalus is not centered under the tibia as the space between the astragalus and the internal malleolus indicates. The line down the center of the tibia shows that there is more of the astragalus external to the line than in the normal ankle.

tive upon which the line of weight-bearing force may be charted.

A line drawn through the center of the shadow of the tibia extends through the center of the shadow of the astragalus. This line may be charted upon the anteroposterior X-ray negative by applying a line to the center of the tibial shaft shadow and extending it downward through the shadow of the astragalus. This vertical line should always extend through the center of the astragalus if the ankle joint is in normal position.

The charting of this described line of weight-bearing force may be made upon the finished negative by means of any straight edge, preferably a celluloid rule.

The interpretation of the plate depends not so much upon the shadow of the lines of fracture as upon the shadows of the relative position of the tibia and astragalus. One must judge of the injury by the position of the astragalus. The anteroposterior position negative gives us the information regarding the mortise between the astragalus and tibia.

To judge the normal or abnormal relationship of the tibio-astragaloid articulation, we must realize that the head of the astragalus is firmly mortised between the lower end of the fibula and the internal malleolus, and is directly beneath the broad articulating and weight-bearing surface of the tibia. This gives only sufficient room between the internal lateral border of the head of the astragalus and the tibia for some ligaments and the action of the joint. This space increases with the slightest torsion fracture of the fibular malleolus for it is due entirely to the integrity of the lower end of the fibula that the astragalus remains mortised correctly.

Provided we have established, by the X-ray, the diagnosis of a torsion fracture of the lower end of the fibula, we are at once interested in methods of reduction and fixation which will promote a functionating ankle as a result. Examination of

Fig. 4.

Fig. 5.

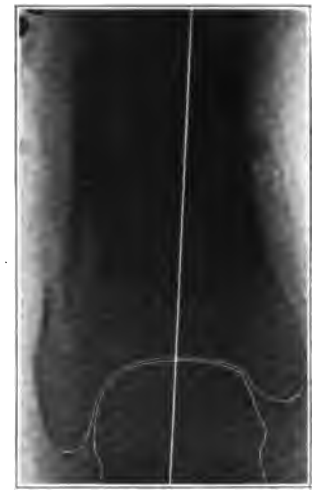


Fig. 6.

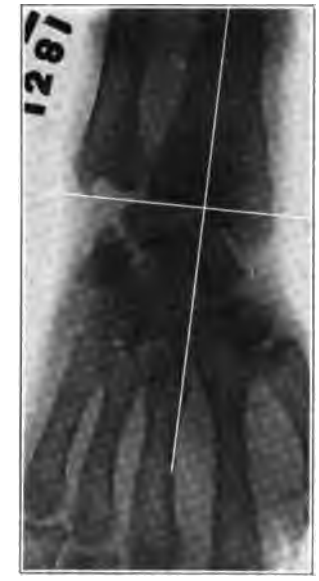



Fig. 7.

Fig. 4. Pott's fracture of the ankle. Taken after attempted reduction. More than three-fourths of the astragalus is external to the plotted line, indicating that further reduction is necessary.

Fig. 5. Fracture of the lower end of the fibula after reduction. It will be noted that the anatomical reduction of the fibula appears to be very good, but the position of the astragalus is not satisfactory, and if the ankle were left in this position there would be an abnormal line of weight-bearing force. This illustrates the necessity of interpreting X-ray negatives with regard to the functional prognosis rather than to the anatomical position of the fragments of a fracture.

Fig. 6. Fracture of the lower end of the fibula without a perfect anatomical reduction of the fragments but with a very good reduction of the astragalus. This case made a good recovery.

Fig. 7. Illustrating the plotting of lines upon the posteroanterior negative of the wrist. In the naturally extended hand the long axis of the radius usually passes through the interval between the second and third metacarpal bones, but this may be a trifle altered if the hand is cramped or influenced by bandages. Note that the styloid of the radius is entirely distal to the horizontal line, which is at right angles to the long axis of the radius and just touches the tip of the ulnar styloid.

Fig. 8.

Fig. 9.

Fig. 10.

Fig. 11.

Fig. 12.

Fig. 13.

Fig. 14.

Fig. 15.

For legends, see p. 241.

a large number of results of ankle fractures, both in hospital and private practice, has taught me that the proper treatment of these cases is extremely difficult. True, the fracture is a slight and simple affair, but the broad, painful ankle that so frequently results merits our attention to details.

The secret of the correction of this fracture lies in the proper adaptation of the astragalus to the tibia. The weight-bearing line of the tibia is transmitted to the foot by way of the articulating surfaces of the tibia and astragalus. It is essential that this relationship be maintained to insure a useful ankle-joint. For years we have enjoyed an epigram something like this: "Take care of the tibia, as it bears the weight of the body; the fibula has no function and will take care of itself." In contrast I would advocate: "Reduce the astragalus and avoid painful ankles." And to properly reduce the astragalus requires attention to the fibula, for by the lower end of the fibula alone is the astragalus properly adapted to the weight-bearing tibia.

Now we know that the integrity of the ankle depends upon how well the low end of the fibula performs this mortising function. The large majority of ankle fractures and chronic ankle sprains are fractures of the external malleolus. It frequently happens that the position of the fragment in a fracture of the external malleolus is in apparently good position, but the mortise of the ankle-joint is sprung open by the slight outward displacement of the fibular fragment. Conversely, we may have a poor alignment of the fracture but a splendid reduction of the astragalus. It is, therefore, unnecessary to pursue futile manipulations of the fibular fragment if the astragalus is in correct alignment.

One will readily see that the slightest displacement of the astragalus, externally, presents a widened ankle space, and if this is not corrected the patient will ever after have an abnormal line of weight-bearing force. In some cases the ankle may adapt itself to the new position, but a little attention to the position of the toes will avoid many painful and weak ankles of tardy convalescence. A good motto for the surgical attendant should be: "Watch the toes; turn the toes in."

It does not matter what the form of fracture at the ankle, whether simple or serious, for, if the anteroposterior X-ray negative shows the astragalus centered under the tibia, the prognosis of a functional result will be more favorable than any anatomical alignment of fragments.

### FRACTURES AT THE WRIST

*Axiom.— The entire styloid process of the lower end of the radius is constantly distal to a line which touches the tip of the ulnar styloid, which line is at a right angle to the longitudinal axis of the radius. The functional result of fractures of the lower end of the radius depends upon the reduction of the radial styloid to this position.*

*Method of X-ray exposure of the wrist.* The difficulty in obtaining and interpreting lateral views of the wrist has led to this charting of the wrist-joint upon a single postero-anterior X-ray exposure. The affected wrist and hand are placed with the palmar surface upon a 5 x 7 inch X-ray plate with the one end of the plate at the web of the thumb. The tube is centered over a point midway between the styloid processes of the radius and ulna. The resulting plate provides shadows of the proximal portions of the metacarpals, the carpus and about three inches of the lower end of the radius and ulna.

---

Fig. 8. Fractured radius. Note that the styloid of the radius is proximal to the cross line, indicating a backward and upward displacement of the radial head. The long axis of the radius now passes down between the third and fourth metacarpal bones, owing to the rotation of the hand and carpal area with the displaced radial head.

Fig. 9. Lateral view of the same case as Fig. 8. This is shown to prove the interpretation made under Fig. 8, and to show the direction of the joint surface of the lower end of the radius when there is a backward and upward displacement. Normally the joint surface of the lower end of the radius exhibits the dorsal edge distal to the palmar edge, but when there is any displacement backward and upward it exhibits just the opposite, which is here illustrated. See Fig. 11 for normal position.

Fig. 10. Fractured lower end of the radius reduced. This is the same case as Fig. 8 after reduction, and while in plaster cast. Note that we now have the normal plotting of the two lines, and the styloid of the radius is distal to the cross line.

Fig. 11. Lateral view of Fig. 10, showing the head of the radius reduced and the joint surface of the radius in normal position. Compare this with Fig. 9. This is the normal position of the joint surface of the lower end of the radius with the dorsal edge distal to the palmar edge.

Fig. 12. Separation of the lower end of the radius at the epiphysis with backward and upward displacement. Note that the radial styloid is proximal to the cross line, which may be interpreted as indicating the displacement of the lower end of the radius.

Fig. 13. Lateral view of Fig. 12, which proves the interpretation of Fig. 12. Note the abnormal position of the joint surface of the lower end of the radius.

Fig. 14. Fracture of the lower end of the radius with displacement of the radial head backward and upward as indicated by the position of the radial styloid in relation to the cross line.

Fig. 15. Lateral view of Fig. 14, proving the interpretation and indicating the abnormal position of the joint surface of the lower end of the radius.

*Anatomical considerations.* In the anteroposterior radiograph of the normal wrist, a line drawn through the center of the long axis of the radial shaft shadow passes between the proximal epiphyses of the second and third metacarpal bones. In backward displacements of the fractured lower end of the radius the radial rotation of the carpal area and metacarpals usually bring this line between the third and fourth metacarpals. But this single line is not sufficient to judge the radial position from the single posteroanterior X-ray negative. So we must add the line at right angles to this longitudinal axis of the radius at a point corresponding to the tip of the ulnar styloid. If the styloid of the fractured lower end of the radius is behind this transverse line, it is not properly reduced, and if left in this position will remain a functionally imperfect wrist.

It does not matter what the nature of the fracture at the lower end of the radius, whether it be an epiphyseal separation in youth or a comminuted fracture of the aged, if the reduced lower end of the radius provides the above normal charting, one may be fairly sure of the functional result.

The functional result depends upon the proper adaptation of the carpal articulating surface of the radius. The articulating surface of the normal radius with the carpus is tilted so that the dorsal edge of the lower end of the radius is always distal to the palmar edge. The correct position of the radial styloid according to the above charting necessitates the normal anatomical position of this articulating surface.

Many writers have described the dropping of the ulna, or the separation of the ulna, as the cause of bad results in Colles's fracture. But these objective findings usually depend upon the tilting backward of the radial articulating surface at the wrist. Furthermore, it does not matter if the apposition of the fragments is faulty in contour if the extension is sufficient to replace the articulating surface to its normal weight-bearing position.

It is the tilting backward of the lower end of the radius that interferes with the function at the wrist, and this can only be overcome by the full extension of the fragment and the consequent normal position of the articulating surface of the radius.

This charting has been applied to X-ray negatives of all varieties of fractures at the lower end of the radius with satisfactory results. Do not try to straighten out the hand where the wrist is fractured, but let it assume a comfortable position. Any unnatural change in the position of the hand alters the relation of the metacarpals to the longitudinal axis of the radius, the first line of our calculations; but such a change in the metacarpal position does not in the least alter the plotting of the position of the radial styloid with relation to the second line, which is transverse to the first line and just touches the tip of the ulnar styloid.

If the entire styloid process of the lower end of the radius is distal to the transverse line at the ulnar styloid process, it implies that the articulating surface of the radius with the carpus is in a correct position for a good functional result.

Nature is wonderfully tolerant of fragments if she can maintain her functional joint surfaces.

# CASE OF PERNICIOUS ANÆMIA TREATED BY SPLENECTOMY; MARKED IMPROVEMENT

By W. S. HARPOLE, M. D., and CHARLES M. FOX, M. D., Chicago

WE desire to report this case thus early because the results are sufficiently suggestive to warrant further operation in this fatal disease. The case was operated in ignorance of the five German cases that have been reported since August, 1913.

The reasons for operating were the following: (1) A case of pernicious anæmia steadily going from bad to worse under the usual medical treatment. (2) The presence of an easily palpable spleen which could not be accounted for by previous malaria or other disease. The enlargement of the spleen suggested the possibility of an hypertrophy due to overactivity of the organ, the possibility that the spleen was perniciously active in a function generally accredited to it, namely, the destruction of red cells. The case has improved since the operation, as have the five German cases, some of which are reported as completely healed. The phenomenon of a great increase of nucleated red cells after the removal of the spleen corresponds to the other cases reported. The color index has fallen ever since the operation.

The patient received a back-set sixty days after the splenectomy, by having an appendicitis with ruptured appendix and somewhat diffuse peritonitis, which was treated by appendectomy and drainage, from which he made a rather slow recovery. At present he is up and about, feeling fine and gaining in health and strength. The history is as follows:

J. D. B., aged 40, comes from Iowa; characteristic appearance for pernicious anæmia. Moderate spinal changes. Gives a history of loss of weight and strength for two years. Had lost much weight in the few months before coming to Chicago, because he had been given a vegetarian diet, to correct the possible auto-intoxication. The blood showed, July 14, 1913 (counted by the Columbus Laboratory): Hæmoglobin, 40 per cent; reds, 1,200,000; whites, 2800; poikilocytes, nucleated reds and megaloblasts. Color index, 1.6.

Treatment ordered: Sodium cacodylate, grs. 2, hypodermatically, every other day. Large doses of hydrochloric acid after meals. Full diet, with a large quantity of meat. The count on August 29, 1913: Hæmoglobin, 37 per cent; red cells, 1,113,600; whites, 5000. Index, 1.69.

The patient was operated upon September 8, 1913. He was given gas-ether. Incision through outer border of left rectus. Spleen delivered after breaking up a few adhesions to diaphragm. Gastro-enterostomy clamp was put on pedicle. The vessels of the pedicle were markedly atheromatous, so much so that the soft clamp ruptured one or two good-sized arteries. The pedicle was doubly ligated and the wound closed. The spleen weighed twice the normal; was firmer than normal. A number of small millet-sized nodules showed on the surface. The cut-surface showed a few of these same nodules scattered through the splenic pulp. Microscopically, there was an increase of connective-tissue elements and decrease in lymphoid structures; also some hyaline degeneration in the blood-vessels. The nodules already mentioned were of connective tissue. The blood-vessels of the spleen were increased in number. The diagnosis of the pathologist was chronic splenitis. Following the operation the patient ran a temperature of about 100° F. for three weeks. This gradually returned to normal. The patient's lemon-yellow color disappeared in ten days. The œdema of face and ankles left in two weeks and has not returned. The drowsiness that the patient had always experienced disappeared three days after the operation. The patient rapidly gained strength and got out of bed on the eighth day, walked about in two weeks, and left the hospital October 5th. The blood counts after operation were: September 10th, two days after operation: Reds, 960,000; hæmoglobin, 20 per cent; whites, 22,000; index, 1.4. September 14th: Reds, 1,100,000; hæmoglobin, 25 per cent; whites, 18,000. September 18th: Reds, 1,212,000; hæmoglobin, 25 per cent; whites, 14,000. September 22d: Reds, 1,420,000; hæmoglobin, 30 per cent; whites, 14,000. September 28th: Reds, 1,618,000; hæmoglobin, 35 per cent; whites, 11,000. October 3d: Reds, 1,760,000; hæmoglobin, 40 per cent; whites, 9400; index, 1.07. November 6th: Reds, 1,968,000; hæmoglobin, 45 per cent; whites, 18,000.

On November 7th the patient was operated for appendicitis, whose presence was possibly indicated by the high leucocyte count of the day before, although he did not complain of a symptom of it until on his way home from the laboratory where the count was made. After the operation for appendicitis the blood rapidly fell off, but soon began to recover. The counts are: November 9th: Reds, 1,440,000; whites, 18,000. November 11th: Reds. 1,220,000. November 27th: Reds, 1,412,000. December 18th: Reds, 1,620,000; whites, 12,000; hæmoglobin, 30 per cent.

Ever since the splenectomy the blood has shown a great number of normoblasts, many more than before the operation. The patient has gone on a trip to the southern part of Illinois, feeling fine, gaining strength rapidly, having a color not noticeably different from the normal.

# THE EXTRAPERITONEAL CÆSAREAN SECTION

## Its Place in Obstetrics

By WILLIAM R. NICHOLSON, A. B., M. D., Philadelphia

IT is an interesting fact that the operation known to-day as the extraperitoneal supra-symphyseal cæsarean section originated in the minds of practical obstetricians more than one hundred years ago. The first man to propose the procedure was Jorg, who in 1806 advocated an intervention in impossible labor which was based upon the observations of many accoucheurs, among whom Boer of Vienna is mentioned, that after the rupture of the upper part of the vagina and lower uterine segment, the fœtus may be found in the abdominal cavity. At that time the classical operation was practically fatal; Blundell, in his "Principles and Practice of Obstetrics," published in 1834, gives a list of twenty-three cases, the only ones performed in England before the year 1821, with fatal results in all except one. This successful case was operated by Barlow in 1793. As late as the year 1866, Playfair stated before the Obstetrical Society of London that the mortality was 89 per cent, and in 1882 Greenhalgh, of Saint Bartholomew's Hospital, could only report one successful case among the ten operated by him.

From the earliest times of which we have record it had been understood that entrance to the peritoneal cavity was accompanied by the most serious risks, and though the real reason was not understood, the operators were more or less close to the truth. Thus Jorg, in his text-book published in 1820, says that the classical operation is fatal in 95 per cent of all cases because of the entrance of air into the peritoneal cavity. In 1860 Nelaton could find no successful case operated in Paris within sixty years, and it is a fact that from 1787 there was no successful case in that city until the year 1879, when Tarnier performed his first Porro operation. The conditions in Vienna during this period were identical, according to Spath, who states that up to the year 1877 there is no record of a successful case in that city. Before 1882 from 64 per cent to 85 per cent died in the best German clinics. It is hardly to be wondered that obstetricians came to the conclusion that not only must the attempt be made to decrease this high mortality, but that the only method was by the avoidance of the peritoneal cavity. One of the men thus impressed was Ritgen, who refers to Mothe of Paris as advocating a procedure practically identical with the Duhrssen vaginal section. In 1821 Ritgen performed the Jorg operation in a slightly modified form but with a fatal result, encountering such severe bleeding that he was forced to complete the operation by the classical method.

It is a pleasure to find that only a few years later eminent American physicians were also concerned with this same question. In the year 1824 Physick proposed to Dewees that the approach to the uterus be made extraperitoneal. This advice is quoted in the text-book of the latter, published in Philadelphia in 1826, and was founded upon anatomical studies of Drs. Horner and Physick. While this operation was never performed, it is recognized by Latzko as being practically identical with the technique known to-day by Sellheim's name. Shortly before this time Baudelocque the younger suggested gastro-elytrotomy. He made two attempts to follow the technique of Ritgen, in the first instance being compelled to desist because of severe vaginal bleeding, while in the second he injured the external iliac and was forced to tie the common iliac artery.

From this time there seems to have been a cessation of activity regarding the matter until the year 1870, when Thomas performed the operation of laparo-elytrotomy. His method was as follows: manual dilatation of the cervix followed by an incision from the symphysis to the anterior superior spine of the ilium. He then dissected down to the peritoneum, which was separated and pushed upward. The cervix and vaginal wall were then exposed and the latter incised upon a sound introduced into the vagina as a guide. The cervix was now drawn through the wound in the vaginal wall into the external wound in the abdominal wall and the child delivered. By this method Thomas performed two operations, the first upon an eclamptic with a fatal result, while the second, in the case of a young primipara with contracted pelvis, was a success. In 1876 Skene had the pleasure of saving two women by this method, and in 1878 the American Gynecological Society sanctioned the operation and gave it the name laparo-elytrotomy. Up to the present time there have

been fourteen of these operations reported: two each by Thomas, Duncan, and Jewett, while Skene had five and Gillette, Hime and Edis each one. The mortality of these cases was 50 per cent for the mothers and 42 per cent for the children, and it is to be remembered that the histories show the majority to have been in so serious a condition that they would have been very bad risks under any plan of treatment. The bladder was wounded in six instances, and the risk of this accident and the general technical difficulty of the procedure caused a halt in its performance, together with the fact that the introduction of asepsis rendered it an unjustifiable operation. It may be stated, however, that in competent hands, at the present day, it should not have a greater mortality than the recently devised Duhrssen-Solms technique.

In preparation for this study I sent out a number of letters to well-known operators in the United States, asking for their experience with and their opinion concerning the present-day extraperitoneal cæsarean, and among the letters in reply I received one from Dr. G. K. Dickinson of Jersey City, which was of so much interest to me that I incorporate it here, since it adds another unpublished case to the list of laparo-elytrotomies and gives a most vivid picture of the obstetrical situation of thirty years ago.

"In reply to your letter of yesterday, I would say that the only operation of that kind with which I was associated occurred so long ago that the notes are meagre and my recollection, perhaps, not altogether correct, although very vivid. Dr. J. J. VanVorst and myself were the surgeons. Dr. W. F. Watson and some others were assistants. The neighbors were aroused, and vengeance was to be meted out to us if we attempted anything. The woman was not consulted. Her husband was tentatively agreeable to have something done. Her history was of several confinements, craniotomies, an agonizing time, and no result. Dr. VanVorst and myself feared the outcome of this case and were very much impressed by an article which appeared at that time termed laparo-elytrotomy. I can remember that we congregated in Dr. VanVorst's office; then, when a messenger was sent, we went around the corner and stood behind the trees with our satchels awaiting the signal. The signal being given we went into the house. It was one of those dark dirty tenements and the last place in the world to do this kind of a job. The woman had been in labor several days. The pelvis was narrow; cervix well dilated and soft; secretions were abundant and the pains came on at five-minute intervals. She was considerably exhausted from a long period of ineffective labor. We put her to sleep, washed her up, used the carbolic of the day, and made an incision on the right side above Poupart's ligament, cutting through all the structures. Coming down on the peritoneum we dissected it up until the vagina was reached. This was opened and the baby extracted. The baby died, also the mother. This was done in a little room about twelve feet square, with one window. The curtain had to be drawn on account of fear of the public. If I remember correctly the woman lived through the following night, but succumbed the next morning from exhaustion, perhaps beginning sepsis. I remember there was some bleeding but not very abundant. What there was we easily controlled by packing. The difficulty was in stripping up the peritoneum and reaching the vagina. Surgery in those days being novelties to the most accomplished, and particularly to us, the local conditions and the psychology of it all rendered the operation more than usually disturbing. So far as I can bring my memory back there is no other incident of importance connected with this case."

Between the years 1891 and 1896 the mortality of the classical cæsarean section may be estimated as about 38 per cent; in the year 1902 it had fallen to 20 per cent and in 1904 it reached the low-water mark, 12 per cent. This wonderful reduction in mortality was, of course, in greatest measure due to the improvement in technique rendered possible by the introduction of asepsis, but it is always to be remembered that it was also to some extent the result of a better selection of cases, it having been early appreciated that the seriously infected parturient was no fit subject for the procedure. As time went on and better statistics became available, it was still more definitely recognized that unless something more was to be added to the equipment of the obstetrician the operation of craniotomy must still be called upon in not infrequent cases, since the mortality of 8 per cent in general practice for this operation is far better than a percentage of 34.3 per cent, which can be shown by statistics to be about what may be expected in a series of cases subjected to the classical operation, after frequent attempts at delivery or repeated examinations have been made by unskilled attendants. The only other alternatives were the much vaunted pubiotomy, hysterectomy either with the extraperitoneal treatment of the stump, or else the so-called cæsarean hysterectomy, and no one of these

operations satisfied the requirements, since pubiotomy was found to be a dangerous procedure in neglected cases from the standpoint of maternal sepsis, while the child had to undergo the ordeal of pelvic delivery at a time when, weakened by the previous traumatisms of labor or human endeavor, it was illy conditioned to withstand any added insults. The removal of the uterus, although giving a better percentage of maternal results than the classical operation in the presence of severe sepsis, could not be considered ideal, if for no other reason than the destruction of the power of reproduction. In fact it was felt that it was a wiser procedure to perforate, and by thus destroying a child, often beyond resuscitation, to save the life of the mother for future childbearing.

Such were the reasons for the proposition, first made by Frank of Cologne in 1907, to perform the operation of cæsarean section extraperitoneally and above the pelvic brim. That there was a real demand for some improvement which would enable the profession to cope with the seriously infected case is evidenced by the enthusiastic diligence of Frank's German colleagues in perfecting and modifying the original technique. There are in the neighborhood of twenty operations now on record for the attainment of the suprasymphyseal extraperitoneal delivery. While in many of them the differences may seem unimportant, to the investigator far removed from the sounds of battle it is necessary, for the full understanding of the subject, that a short résumé should be incorporated here, though among the number there are certain performances which can only appeal to the surgical contortionist.

The anatomical facts upon which all these operations are dependent are, first and most important, the distention of the lower uterine segment; secondly, the migration of the peritoneum during pregnancy, whereby the bladder is more or less deprived of peritoneum and becomes in late labor uncovered by the peritoneum above and in front; thirdly, the growth of the peritoneum due to the hypertrophy of pregnancy; and, finally, the loosening of the peritoneal reflection over the lower uterine segment, which, as is so well shown in vaginal cæsarean operations, enables it to be separated from the uterine wall with the greatest ease.

As early as the year 1908, Holzapfel was able to enumerate sixteen different methods for the performance of the suprasymphyseal extraperitoneal cæsarean section and since that time there have been several further modifications, but these, with the exception of the Duhrssen-Solms technique, are of little importance. The last mentioned operation is unique and will be mentioned later.

Frank of Cologne was the first man in recent times to propose the extraperitoneal method, and therefore the classification of these various procedures is headed by his method, which was as follows: The abdominal wall was opened by a Pfannenstiel incision, and the parietal peritoneum was incised transversely, as was also the uterine; the latter was then separated from the anterior face of the uterus and joined by stitching to the parietal peritoneal leaflet; finally the uterus was incised transversely. This method is known as Frank's first technique and is in reality a transperitoneal operation. His second method attempts to fulfill the aim of true extraperitoneal attack and was performed as follows: After incision of the abdominal wall as in the former method, a small opening is made in the parietal peritoneum for the orientation of the bladder, and this organ is freed from its peritoneal coat by blunt dissection, or, where needful, by a few cuts of the scissors; the incision into the parietal peritoneum is then closed and the uterus is opened as in the former method.

The Veit-Fromme original technique is identical with Frank's first method except that after the uterus has been closed the peritoneal flaps are again separated from one another and united as before operation. As a modification of this technique the same authors have presented the following, which is in our opinion the best of all the manifold methods by which this operation may be performed: the abdominal wall is incised longitudinally, as is also the peritoneum, both parietal and visceral; these two layers of peritoneum are then brought into apposition by clamps, and after the delivery has been accomplished through a median longitudinal incision into the lower segment, the peritoneal flaps are reunited in their original relations.

One of the earliest to enthusiastically adopt the idea of Frank and Veit was Sellheim, and he has published four different modes of procedure. His first method is a true extraperitoneal technique: Pfannenstiel incision through the skin and fascia, separation of the recti longitudinally, separation of the subperitoneal tissue from the under surface of the recti, distention of the bladder with solution to aid in its orientation, loosening of the peritoneum from the top of the bladder, and finally the upward displacement of the unopened sac of peritoneum with coincident downward displacement of the bladder below the symphysis.

The uterine incision is made in the middle line of the lower segment and is vertical. In his second method the technique is as just detailed until the parietal peritoneum is reached; this is incised transversely and through this incision the uterine peritoneum is similarly incised and the two flaps thus formed are united by stitches. The peritoneum is then pushed up and the bladder is displaced downward. The only difference between the method just described and his third method is that in the latter the folds of peritoneum are united by a double layer of catgut stitches. Sellheim's fourth method, however, is a wide departure from his previous three plans and is an attempt to treat all cases, of whatever grade of infective virulence, by suprasymphyseal operation. It is known as the method by utero-abdominal fistula and is performed as follows: Median incision through all abdominal layers, including the serosa of the lower segment. The parietal serosa is then stitched on the skin surface and the uterine serosa, after lateral separation from the uterine wall, is stitched upon the parietal near the edge of the skin incision. A median incision is then made in the lower segment of the uterus, and the incised edges are drawn forward into the abdominal wound during the delivery. After the birth has been completed the edges of the uterine wound are sutured to the skin surface. The orifice thus left is packed and allowed to heal by granulation.

Pfannenstiel advocates the incision known by his name, through the skin and fascia with a longitudinal separation of the muscles, a longitudinal incision in the peritoneum, and a longitudinal incision in the lower segment of the uterus.

Baumm advises the same technique as Veit's first method, with the exception that he sees advantages in the clamping of the peritoneum, instead of stitching it, during the delivery.

Rubeska offers a method for badly infected cases. He makes a median incision in the abdominal wall and stitches the parietal serosa around the area to be incised before opening the uterus. The uterine wound is treated by the open method. This is a similar procedure to Sellheim's fourth method.

Doederlein is a strong advocate of the true extraperitoneal technique and attempts it by an initial inguinal incision followed by dissection of the parametrial tissues without exposing the peritoneum. After reaching the lateral aspect of the lower segment, the bladder is displaced laterally without separating the peritoneum from it, and the uterus is opened in the median line. Drainage is a part of his usual technique.

Czyzewicz prefers the median abdominal incision until the peritoneum is reached and then follows Sellhem's first method for the balance of the procedure.

Hoffmeier in his earlier work followed the technique of Veit's second method, the only difference being a continuous seroserous suture, non-separation of the united flaps of peritoneum and the use of drainage. His second method simply consists in a median section through the abdominal wall and through the uterus as low as possible. One of the methods which seems to have attracted a large number of foreign operators is Latzko's. This operator fills the bladder with 150 ccm. of sterile solution and then makes a 12 cm. incision through the recti, which are laterally displaced. The bladder is then loosened from the lateral aspect of the cervix to a degree which permits a side displacemnt of the former with one rectus muscle; the uterus is opened longitudinally and the uterine wound is drained.

Probably the most remarkable form of intervention is the procedure known as the Duhrssen-Solms technique. In this method the abdomen is opened by an incision parallel to Poupart's ligament and the tissues are separated by blunt dissection until the uterus is reached; during this dissection the epigastric vessels must be ligated. A vaginal cæsarean is then performed and the wound in the uterus and the wound in the abdomen are brought into coincidence by traction, the child being delivered above the symphysis.

A decided simplification of the above confusing array is made possible by classifying them on the basis of essential differences; thus the Frank, Veit-Fromme, Baumm, Pfannenstiel, Hoffmeier, and the second method of Sellheim are all transperitoneal methods, their differences only consisting in various means of closing the peritoneal folds (parietal and visceral) and whether or not these same folds of peritoneum, which have been united for the moment, are again restored to their original anatomical relations before closing the abdomen. There are three other divisions by which all the other important methods may be classified, as follows: the utero-abdominal fistula technique of Sellheim and Rubeskathe, true extraperitoneal technique of Sellheim and Latzko, and finally the Duhrssen-Solms technique. While opinions among the continental operators differ widely as to the value of the various operative methods described, and while, of course, each creator of an individual method is enthusiastically in favor of his modification, it seems fairly clear to a non-prejudiced investigator that the Veit-Fromme modification of the Frank operation

and the second Sellheim technique are the only methods which are truly surgical. Most of the other procedures, if not absolutely all of them, are either founded upon the principle of making the operation as difficult as possible, or else the distinctive modification is of such a nature that suspicion is aroused that the author was anxious to drive a nail upon which he might hang his name.

Sellheim makes the objection to Latzko's method by lateral undermining that it is not suitable for all cases, and to Doederlein's that sufficient space is often not afforded for an ample uterine incision, and that there may be, therefore, severe uterine lacerations produced by extension during extraction of the child.

In order that a definite foundation be established for the further consideration of the subject, the Veit-Fromme method and the second method of Sellheim will now be considered in detail.

Veit was one of the first to advocate the operation which is known as that of Frank. Fromme in 1908 reported eight cases from Veit's clinic, in the first four of which the technique was exactly that of Frank. In the fifth case the parietal and visceral peritoneum were separated after the birth of the child, and were restored to their normal relations. In the remainder of the series the transverse section through the skin, subjacent tissues and uterus was given up and in its place was substituted the longitudinal incision. This modification is performed as follows: the skin, fascia and recti muscles are separated vertically and a vertical incision is made into the parietal peritoneum. The visceral or uterine peritoneum is then incised vertically in the median line of the lower segment, beginning at the lowest possible point of the vesico-uterine plica and extending upward to the point at which the peritoneum becomes intimately attached to the uterine wall. In advanced labor the lower segment has become so distended that a space of from 10 to 12 cm. is available for this incision. The peritoneum of the visceral layer is then mobilized somewhat laterally, which is easily done by blunt dissection, and then the two peritoneal flaps, visceral and parietal, are either stitched or clamped. A vertical uterine incision is made into the lower segment and the child is delivered. The placenta may be delivered at once, as in the classical operation, or it may be awaited and expressed by fundal pressure either before or after the uterine incision is closed. The uterus is best closed by a running stitch, reinforced by a second one as in intestinal suture. The abdominal wound is closed by the layer method and no drainage is used. The chief advantage of this method, in the opinion of its originator, is that the bladder is not disturbed. (There is one distinct disadvantage in this technique, however, in that there may be difficulty in obtaining ample space for the uterine incision if performed during the early stages of labor. It is well to remember also that the fear of bladder necrosis from separation is in all probability not well founded.)

In Sellheim's original operative procedure, he made the attempt to separate the bladder from the peritoneal fold without opening the latter, and then by upward displacement of the unopened peritoneum and downward displacement of the bladder to obtain enough space to deliver the child. It was soon found, however, that not only was it impossible, in many cases, to avoid opening the peritoneum, but that the bladder was liable to injury by the attempts at separating the peritoneum unopened. This method has, therefore, been very generally given up, and he has substituted the following, which is in reality not a true extraperitoneal but rather should be designated as a transperitoneal method. He operates under scopolamine-morphine twilight sleep, with spinal anæsthesia. The high Trendelenburg position is used, and at present the incision is made in the longitudinal direction instead of the Pfannenstiel, which was the case in his earlier works. The fascia and recti muscles are separated vertically and the peritoneum is separated from the under surface of the recti to a considerable distance on each side along the upper border of the empty bladder. The peritoneum is now opened at the attachment of the urachus to the bladder. The incision in the peritoneum is prolonged to left and right along the firm attachment of the peritoneum to the bladder, curving the incision laterally and posteriorly on both sides toward the floor of the vesico-uterine fold, while the bladder is drawn forcibly forward. A transverse incision is now made at the boundary between the loosely attached peritoneum in the vesico-uterine fold and the firmly attached bladder peritoneum. This transverse incision is prolonged on both sides into those portions of the anterior delimiting incisions which curve toward the side and back. The delimiting incision begins at the portion of the bladder peritoneum which remains undisturbed. The visceral layer of the peritoneum is now dissected away from the uterus in an upward direction as far as possible. The two leaves of peritoneum, the parietal and the visceral, are now united by suture of their free edges, and care must be exercised here to avoid incomplete closure of either extremity of

the transverse incisions; in other words, it is necessary to completely close the peritoneal cavity by suturing the peritoneal leaflets well out onto the broad ligaments if necessary, not only to avoid contaminating the peritoneum but also to avoid the possibility of omental or intestinal strangulation. The bladder is now separated from the cervix and drawn forward over the symphysis and pressed against it. (It is better to allow the bladder to drop down behind the symphysis after its separation from the cervix and to retain it there by a suitable retractor.) The anterior face of the lower segment being thus prepared, the incision is made in the median line in a vertical direction. Primarily but about 5 cm. are incised, beginning at a point about 4 cm. below the upward displaced peritoneal fold. The tip of the special lever, devised by the author for the delivery of the head, is introduced into this slit by the aid of lateral stretching and adapted to the head, while at the same time the lower angle of the wound, which is constantly stretching and becoming more accessible, is incised as far as is necessary to allow the full application of the instrument. The head is now raised from its bed and pried forward, and one pole of the presenting part is seized. The artificial cervix (uterine wound) is continued downward as far as needful for the passage of the entire head. The child is delivered, and the initial sutures passed at the upper and lower angles of the uterine wound. The peritoneal suture line is now carefully inspected and then the placenta is delivered manually and a uterine tamponade inserted, its lower end being led into the vagina. The uterine wound is closed by interrupted sutures, and this suture line is reinforced by a continuous catgut stitch, with the exception of a small space at the lower angle of the wound, which is left open in order to have a safety valve through which one may later reopen from the vagina, if there be need.

If at the time of delivery there be infection present, a strip of gauze may be carried through the lower angle of the wound into the vagina and the abdominal wound be drained by a Mikulicz. If the case be a clean one the peritoneal reflection may be attached to the bladder and secured with a few interrupted sutures to the lower portion of the rectus muscle. The abdominal wound is closed by continuous suture of catgut in the muscles and fascia, and any skin method which is desired.

In this multiplicity of operative technique there is, as has been said, one salient difference which divides them all into two great groups, namely: whether or not the general peritoneal cavity is opened in the preparation of the lower segment for incision, or, in other words, whether the operation is performed in a truly extraperitoneal manner by lateral displacement of the bladder, vesical plica, and unopened peritoneal sac, or whether, in the performance, the abdominal cavity is temporarily opened. It goes without saying that, technically, extraperitoneal section means extraperitoneal section, a procedure carried out from start to finish without entering the true cavity of the belly, and this would be the ideal method but for two facts which render its use less favorable: first, that it is a much more difficult procedure than the transperitoneal method, and, second, that it does not offer any greater advantage in the way of improved results than does the latter.

In the consideration of the two methods of operating through the lower segment, it must be apparent to any trained abdominal surgeon that the attempt to proceed truly extraperitoneally will be vastly the more difficult, since, to obtain the best exposure, a lateral abdominal incision of quite considerable extent is primarily necessary, with subsequent blunt dissection and displacement laterally of the bladder and vesical plica, in order to make the only proper median uterine incision. It is hardly necessary to offer a detailed censure of the transverse or the lateral uterine incision, as the unnecessary dangers which they make imminent must be at once apparent. Moreover, in the true extraperitoneal method the peritoneum is actually opened in a non-negligible percentage of cases, even in expert hands, and there is also the danger of deprivation of the vitality of the peritoneum by its separation. In addition, the bladder is so likely to be injured that the advice is given by some to open the parietal peritoneal layer for its orientation, which is, of course, a confession of weakness on the part of the adherents of this method. In the consideration of this problem, then, it is to be understood that the term extraperitoneal cæsarean section is taken simply to mean that the selected portion of the lower uterine segment has been made extraperitoneal before its incision.

With these qualifying statements in mind we may now consider the first of the two major questions of the problem, namely, are we in possession of a method whereby infected cases may be treated with a favorable prognosis for the mother and the child? Academically this question may be answered as follows: Cases which present themselves with the signs of a developed infection of a severe grade are not suitable for this procedure, as experience has

membranes at the time of operation. Twenty-four were operated by the transperitoneal method and both deaths occurred in this group. With the exception of the ten cases all were of the suspicious class or, as he says, "more or less unclean." He is an enthusiast and believes that craniotomy, pubiotomy, the classical cæsarean, and to some extent premature labor, will be crowded out by this operation. He followed Latzko's technique and believes it to be the best.

Kustner reports fifty-five cases with two deaths from peritonitis. One of these was clean and one was suspicious. In neither fatal case was the operation truly extraperitoneal. All the other cases did well. Some of them had temperature in the puerperal period and two of the children were lost. He would limit the classical cæsarean to cases in which some other intra-abdominal operation is necessary. He would perform the extraperitoneal cæsarean section if, the membranes being unruptured, it is certain that the child cannot pass the pelvis. If there is some doubt as to the possibility of engagement he advocates the test of labor, with the performance of the extraperitoneal operation if it becomes necessary. Kustner would limit pubiotomy, even in multiparæ, and believes in the extraperitoneal operation in infected cases, and would employ it even if there was some question as to the condition of the child.

Doederlein advocates pubiotomy to 7 cm. conj. vera in multiparæ, as he considers the extraperitoneal operation to be more formidable. In infected cases both the extraperitoneal operation and pubiotomy invite danger, and craniotomy is indicated. In thirty-two cases this operator lost three mothers and two children and two other children died in the first week.

Baisch reports fifty cases. In three the true extraperitoneal type of operation was not possible and in sixteen there were small peritoneal wounds made by the separation. Three women died from eclampsia, ileus, and sepsis, respectively, and six of the children were dead at birth. This author thinks that the operation is best for the suspected case without temperature, but with a probable infection of the liquor amnii.

Henkel reports twenty-five cases and states that most of them were at least suspicious. He operated by the transperitoneal route entirely and had no maternal fatality. Opitz also operates transperitoneally. He is able to report a series of sixteen cases, of which some were suspicious, with one maternal death. Bumm lost three women in his series of forty-two cases, and the deaths were all due to infection. Walcher is an adherent of the transperitoneal technique. In his series of fifteen cases he lost one mother and two children. Romer draws the conclusion from his statistics that the mother is safer under the operation of pubiotomy, when performed in proper cases, than under the extraperitoneal section, but that the mortality of the children is greater. Thus pubiotomy gave, in his hands, a maternal mortality of 1.7 per cent and a fœtal mortality of 6.8 per cent, while the extraperitoneal section resulted in a 6 per cent maternal and but 2.4 per cent fœtal mortality. Latzko studied one hundred and fifty cases from the literature and calculated a general mortality of 7.3 per cent and a mortality from septic causes alone of 5.4 per cent. Jeannin collected one hundred and forty-eight cases with eight maternal deaths from infection, two from eclampsia and one from other causes, thus giving a maternal mortality of 7.45 per cent, with a purely septic mortality of 3.04 per cent. His statistics combined with Latzko's give a maternal mortality in one hundred and ninety cases of 7.37 per cent, and from infection alone a maternal mortality of 4.21 per cent. The morbidity was also high in this series, being 30.7 per cent total, with a morbidity of 25 per cent due to infection alone.

Lewis collected one hundred and two cases from the literature and calculated the maternal mortality to be 8.8 per cent while the fœtal was 8.6 per cent.

Taking the statistics which have been given as a basis for judgment, it appears then that we may admit that in the "suspected case," with the baby in good condition, we will conserve the interests of the mother by the performance of the suprasymphyseal extraperitoneal cæsarean section in preference to the classical, and that the mortality of the child from the operation should be but little greater than by the latter.

Now as to the employment of the procedure in cases in which there is no question of infection, or in other words, in elective operations in clean cases.

Anyone reading Sellheim's paper[1] without having had any actual experience with the usual type of cæsarean operation would certainly conclude that it was an absolutely unjustifiable procedure. After stating that the Poro cæsarean is less dangerous in truly infected cases than the extraperitoneal cæsarean, he enumerates the following appalling list of dangers associated with the former procedure: intestinal wounding, greater loss of blood, loss of procreative power, longer rest in bed after operation, later return

[1] Zentralbl. f. Gynäk.

to work, abdominal hernia, bad cosmetic result, and finally, disturbance of the respiratory function of the child by the forceful forward displacement of the uterus outside the body of the mother, with resultant infection of the child from inspiration or swallowing of infected liquor amnii. Moreover, he believes that there is as much danger of wounding the bladder in the classical operation as in the extraperitoneal, and in addition that there is great danger of infection of the peritoneum, either by soiling at the time of operation or by later leakage from the uterine wound. In addition the uterine cavity may be infected, there may be intestinal or omental adhesions, fixation of the uterus to the anterior abdominal wall, weakening or rupture of the scar in later pregnancy, and abdominal hernia. He says: "Extraperitoneal uterine section is identical with vaginal cæsarean section, all technical difficulties having been removed."

If ever there was an instance of special pleading we have one here. It would have been a perfectly justifiable arraignment of the classical operation if it had been published before the days of the aseptic era, but, in the light of our knowledge of the results which have been obtained in the classical operation in modern times, it is hard to understand how a man could become so blindly enthusiastic about any method, even one bearing his own name, that he could disregard the cold facts as attested by operators throughout the world regarding the Sanger operation in clean cases. Admitting as we have that the extraperitoneal operation is of advantage in a limited group of cases, and further admitting for the sake of argument that in perfectly clean cases, in the hands of men having had experience with this type of operation, the statistics for both mother and baby may, in the future, be as good as those now available in the Sanger operation, we are nevertheless forced to conclude that the burden of proof still rests upon the new operation.

Difficulties in orientation of the bladder, injuries of the bladder, extension of the uterine incision, and increased difficulties in the delivery of the child are factors to be reckoned with in the two methods for the performance of the operation recommended in this paper. If some of the other methods, as Latzko's, be undertaken, we have the added dangers of wounding of the great vessels and the uterers, while the peritoneum is injured in a non-negligible percentage of the reported cases by all true extraperitoneal methods. While it is of course perfectly justifiable to assume risks in order to avoid imminent dangers in obstetric, as in other surgical procedures, it is certainly somewhat illogical to advise the giving up of a method such as the Sanger operation, with its well-established technique, in favor of a procedure which, to say the least, smacks of a return to the pre-antiseptic days. Particularly is this true if we remember that in a series of three hundred cases Leopold was able to report a mortality of 1.2 per cent, that Pestalozza in a series of 111 cases had a mortality of 2.08 per cent (omitting four cases which were infected previous to operation), and that Richter of Dresden in a series of 107 cases was able to report a mortality of 0.9 per cent for both the mothers and the children. This last report of Richter is important from two standpoints; the first, already mentioned, is the actual mortality, while the second appears upon analysis of his series of cases, by which it is found that five of these cases had prolapse of the cord and that fifteen were second operations (of these there were three upon whom the operation of Frank had originally been performed), among whom he found that there were four presenting intestinal and omental adhesions and that in seven instances there were adhesions, mostly slight, between the parietal peritoneum and the uterus. Can any practical man, approaching the subject without creative bias, convince himself that it is justifiable to advocate a procedure which is admittedly, even by its advocates, a much more difficult performance, as a substitute for an operation whose only dangers are those inseparable from all intra-abdominal surgery? In the vast number of cæsarean sections by the usual methods, there are some twenty-six cases on record in which the uterine scar ruptured in subsequent pregnancy.[1] In the operations upon the lower uterine segment there are none as yet, though among the few cases in whom pregnancy has been observed after the suprasymphyseal operation there have been one or two cases in which at the time of the second operation the original scar was so greatly stretched that rupture seemed imminent; but it is admittedly no great danger in either type of operation, on the grounds of the universal experience with the Sanger operation, even with imperfect suture methods, while the knowledge we have lately gained as to the subsequent behavior of the scar after the vaginal cæsarean section will at least allow us to assume the like for the extraperitoneal method. In so far as adhesions are concerned, it is proven that intestinal and omental adhesions of a degree sufficient to interfere markedly with the health or life of the patient are at least rare

[1] Dahlmann, Inaugural Dissertation, Jena,

after the usual cæsarean delivery, but admitting that they do occur rarely and realizing that there can be no intraperitoneal adhesions in a clean case which has been operated upon by the extraperitoneal method, we must not fail to remember that there may be just as troublesome results of an adhesive nature after the operation now under investigation; for it is to be remembered that while there are many points of similarity between the suprasymphyseal and the vaginal cæsarean there are also points of difference, in that in the former there is an abdominal wound which greatly increases the risk of adhesive trouble in the region of the uterus. Whether this last mentioned difficulty is real or imaginary can only be proven by the future.

A very important question which must now be considered is the effect of the extraperitoneal suprasymphyseal section upon subsequent pregnancy, and secondarily whether repeated operation in the lower uterine segment is likely to be more difficult than in the first instance.

It is, of course, too soon to be able to gather a large and convincing mass of statistics bearing upon these points, but still there is enough to enable one to at least form a tentative judgment. Hartmann,[1] reporting from Frank's clinic, is able to publish a most interesting paper upon this subject in which he states that "as early as September, 1908, he had seen one woman twice spontaneously delivered following the extraperitoneal cæsarean by Frank's method." In the same paper he reports upon four cases who had undergone the operation twice and upon two cases who had three times been delivered in this manner. In none of these women were there any difficulties observed during pregnancy and in no case was there a retrodisplacement of the uterus. The first case at the second operation showed a small hernia. She had been drained at the original operation. There were no peritoneal adhesions and no difficulty was experienced in separating the peritoneal folds. There was no uterine scar to be seen and the child was delivered spontaneously through a transverse uterine incision. The second case, after six hours of labor, showed a thinning of the uterine scar suggesting the possibility of rupture, but the operation was completed without difficulty. In the third case there was not only no difficulty but there was no need to do more than push up the peritoneum before making the uterine incision, as the bladder was uncovered. In this case also there was entire absence of any uterine scar. In the fourth case there was some trouble in orientation of the bladder and also in the separation of the peritoneum. This patient developed chills and a urinary fistula subsequent to operation. All these cases had been drained through the abdominal wound and the second operations were all transperitoneal. In the fifth case, one of the two upon whom the operation had been done twice previously, he found a hernia and also some muscle adhesions, and in the sixth case, at the third operation, while there was no hernia there was some scar tissue in the uterine wall at the site of the old incision. Sellheim has reported five cases previously operated by his technique, in three of whom labor progressed to a spontaneuous termination, while in the remaining two he again delivered by his method. In both the operative procedure was more difficult, and the author puts especial emphasis upon this point in several of his articles. In one of the patients there was a widening of the uterine scar, but this was not the case in the other. Mayer reports two cases upon whom an attempted second extraperitoneal operation failed in each instance because of the adhesions between the uterus and the parietal peritoneum. He was compelled finally to resort to the fundal incision to accomplish delivery. In neither of these women was there any stretching of the uterine scar.

Traugott, however, has reported one case in which the scar was about to rupture. Litschkuss (1912) mentions two cases of labor following a previous delivery by Latzko's method, in one of whom birth was spontaneous, while in the other delivery was by the classical operation.

It is thus to be concluded that, in so far as we may judge by the statistics at present available, there is at least no marked tendency to rupture of the old scar or other difficulties in future pregnancy, that labor is not likely to be influenced by adhesions, but that if a second extraperitoneal operation be undertaken it may be found to be impossible and in any event will probably be found more difficult in a large proportion of cases.

In the preparation of this study it seemed to me to be fitting to collect the representative American opinions upon the subject, and I therefore sent out a list of questions to a considerable number of well-known operators in this country. I asked that the questions be answered theoretically if the recipient had no practical experience to offer.

Among the replies which I received there were but three who had had any practical experience, namely, Dr. Dickinson, whose case of elytrotomy has been earlier mentioned, Dr. Howard A. Kelly,

[1] Gynäk. Rundschau, 1909.

and Dr. B. C. Hirst. Dr. Kelly has performed the operation once in a clean case before labor with a good result for both mother and child. He thinks favorably of the procedure and indeed is of the opinion that it may in the future become the method of election in all cases. Dr. Hirst is enthusiastic with regard to the future of the operation. He has used various techniques, namely, those of Bumm, Sellheim, and the Veit-Fromme, the latter with modification, and upon the experience gained by a series of some seven cases he would at the present time use the method except in the severely infected case, to the exclusion of the classical procedure.

With the exception of these two operators the consensus of opinion is absolutely opposed to its performance in clean cases, and in but a small proportion of replies was it admitted that it had any field of usefulness. Some half a dozen men advocated its use in septic cases, there apparently being no very definite understanding as to the true field. But two men essentially agree with me in the opinion expressed in the body of this paper when considering the indications. The general expression of opinion may be epitomized as follows: The difficulties and dangers of the operation are so much greater than those met with in the classical procedure that any possible advantage possessed by the method is nullified. Believing as I do that the operation has a true field though a limited one, and also believing that the future may show that the indications for the operation may be broadened by the advance in our diagnostic ability regarding not only the determination of the variety of micro-organism present but its import from the standpoint of virulence, it seems fitting, in view of the attitude of the vast majority of the leaders of the profession in this country, to say something here with regard to the technical difficulties of the extraperitoneal cæsarean section. That it is a more difficult procedure than the ordinary intraperitoneal cæsarean is admitted, but the mere difficulty of an operation, if it has advantages not possessed by any other, cannot be admitted as an argument against it, and in this instance the difficulties have been very much magnified. This I believe is due to the fact that in this country we have been led astray by the insistence of many of the foreign operators upon the extraperitoneal element of the operation, and have not realized that any case suitable for section can as well be done by the transperitoneal as by the extraperitoneal method. That this is true is evident from the fact that in both forms of procedure the uterus is left *in situ*, and if its substance be virulently infected trouble surely will result in the one as in the other; while if there be a virulent infection of the liquor amnii the damage will be greater in the true extraperitoneal than in the transperitoneal since in the former large areas of connective tissue are opened up, while in the latter these same areas are undisturbed. If now, realizing these facts which have been gradually evolved by experience, we consider the difficulties of an operative procedure such as Sellheim's second method or the Veit-Fromme technique, I believe that it will be found that the difficulties are more imaginary than real to the operator experienced in abdominal work. I cannot agree with Sellheim that the operation is identical with the vaginal cæsarean, "all technical difficulties having been removed," or with Frank or Spaeth, who consider it a suitable operation for the general practitioner. I do believe that it is more difficult than is the vaginal cæsarean upon a multiparous woman, and that it is more difficult than the ordinary abdominal cæsarean, and I do not believe that the unskilled man has any business with any of these operations unless under exceptional circumstances of isolation. But for the skilled obstetric surgeon the necessary variations in technique will be easily mastered. I believe that this operation will be performed in this country, for the proper indications, by a rapidly increasing number of surgeons, with gratifying results, and I furthermore believe that it will in all likelihood be performed by the following technique, which is not only relatively, but actually, simple and easy of execution. With the patient in the moderate Trendelenburg position a median longitudinal incision is made from the symphysis to within a couple of inches of the umbilicus. The fascia and the muscles are then separated in the same direction and to the same extent, thus avoiding the use of the Pfannenstiel incision, a distinct advantage in suspect cases, since there can be but little doubt that this incision is more prone to suppuration than the ordinary longitudinal one, and if infected will give a much more serious condition. The parietal peritoneum is then opened by an incision about two inches in length and the upper limit of the mobile portion of the visceral peritoneum is ascertained. This uterine peritoneal layer is then incised from the top of the bladder to the point where it becomes firmly attached to the anterior wall of the uterus. This last mentioned layer of peritoneum is then separated laterally on each side of the median line for a couple of inches throughout the length of the incision. The conditions at this point of the

procedure are as follows: the abdominal wall, exclusive of the parietal layer of the peritoneum, has been incised from the symphysis pubis to a point several inches above, thus giving ample room in which to work; the parietal peritoneum has been incised from the lowest point possible, namely, the top of the bladder, to a point which corresponds to the situation of the lowest area of firmly attached uterine peritoneum; while the uterine peritoneum has been incised to an identical degree. These two peritoneal leaflets are now united by a continuous buttonhole stitch of catgut. An oval opening is thus produced, the upper extremity being formed by the attachment of the free parietal with the agglutinated portion of the uterine peritoneum, while the lower extremity is formed by the union of the anterior and posterior folds of the vesical plica at the upper edge of the bladder. A longitudinal incision in the uterus of about 12 cm. gives ample space for the application of the forceps, which instrument serves the purpose better than the special hooked lever invented by Sellheim. The amount of bleeding is usually not as great as during an intra-abdominal cæsarean, and moreover, in one instance in which it was profuse during the delivery of the child, it ceased at once as soon as the birth was completed, due to the occlusion of the blood-vessels by contraction of the lower segment. The uterine wound is decidedly reduced in size after the delivery, and is closed by a double layer of catgut as in intestinal suture. A continuous catgut stitch closes the stitched folds of the peritoneum and the remainder of the operation is completed in the usual manner. In a suspect case, of course, the necessity for drainage may alter this method of closure. The technique just described is the Veit-Fromme, with the modification that the folds of peritoneum are sewn after their primary incision instead of using clamps to make the closure. One of the great advantages of the method is that the bladder is not displaced, while the use of the median incision through all the layers obviates the dangers of infection of the large areas of tissue exposed by the Pfannenstiel abdominal incision and by the lateral extraperitoneal attack.

I have been able to collect eight cases done by American operators. Seven of these were performed by Dr. Hirst and one by Dr. Kelly. There may be many other cases, and it is to be understood that no claim is made that this is a complete list, but I have been unable to find any other reports either in publications or by personal letter. I will therefore insert a short synopsis of the case histories.

CASE 1 (Hirst). This patient was a primipara and had been in labor for twenty-four hours. Her membranes were ruptured when first seen. Examination showed a c. v. of 8 cm. and the head of the child was large. Forceps were applied twice before sending her to hospital. In the first attempt the application was made with due regard to asepsis, but, failing to engage the head, the family physician attempted to deliver by the use of his forceps, which he applied without any sterilization. In this case the Bumm technique was employed. The peritoneum was inadvertently opened but immediately closed, and the mother and child made a good recovery.

CASE 2 (Hirst). Had a history of one miscarriage and one child delivered by high forceps at the seventh month. A rhachitic dwarf with a c. v. of 9.25 cm. Several examinations had been made upon her outside of the hospital by the students. Temperature on admission was 99° and her pulse was 112. Had been in labor for 36 hours without engagement and was delivered by Sellheim's first method. Mother and child discharged in good condition.

CASE 3 (Hirst). Primipara with a true conjugate of 8.75 cm. In labor for 36 hours before admission; no engagement; was delivered by Sellheim's second method. Had a slight febrile reaction for a few days. Mother and child discharged in good condition.

CASE 4 (Hirst). Multipara. All three of her previous labors had been very difficult. Conjugata vera 8 cm. She was a house case and had been in labor for 16 hours, without engagement, at the time of the first pelvic examination. An examination made at this time resulted in rupture of the membranes and prolapse of the cord. She had hard and regular pains. Delivered by Sellheim's second method. Had a badly infected wound giving rise to fever from the second to the ninth day. Both patients discharged in good condition.

CASE 5 (Hirst). Multipara. Conjugata vera 8.25 cm. Was a house case and at time of operation the membranes were still intact and the pains had not been severe. Had been in labor about 24 hours. Was delivered by Sellheim's second method and had a moderate infection of the wound with consequent temperature from the second to the ninth day. Both mother and child recovered.

CASE 6 (Hirst). Primipara. Had been in labor four or five days. The membranes were not ruptured and there was no engagement. Had a justo minor pelvis of the fœtal type, with marked outlet contraction in both the transverse and posterior sagittal diameters. Was operated by the Sellheim second method and the bladder was injured, but the rent was immediately closed and no trouble resulted. Badly infected wound. Both patients discharged in good condition.

CASE 7 (Hirst). Multipara. Conjugata vera 7.5 cm. Head large and high, overlapping the symphysis markedly. Previous history of difficult labors. Was not in labor. In this instance the Veit-Fromme technique was employed with the greatest satisfaction. The lower segment was markedly dilated, due to the high position of the head, and there was ample room to work. Afebrile convalescence with primary wound healing. Child discharged in good condition.

CASE 8 (Kelly). Had been delivered of five still-born children. Conjugata vera 6.25 cm. Operation performed before labor had started. Pfannenstiel incision; recti separated but not detached, and only the right half of the bladder was separated. The peritoneum was not opened, as there was ample exposure. Longitudinal incision into lower segment, membranes ruptured and child delivered without forceps. Little bleeding after rupture of membranes and but moderate hæmorrhage on incising the lower segment. Both patients discharged in good condition.

## CONCLUSIONS

The extraperitoneal suprasymphyseal cæsarean section is an addition to the obstetric armamentarium.

Its chief indication is the "neglected case" or one that is mildly infected. Since the prognostic differentiation between the various degrees of septic infection is a matter of uncertainty, the operation, in the words of Sellheim, is "of the nature of an experiment in many cases."

The operation is absolutely contra-indicated in the seriously infected case.

The performance of the operation in clean cases is attended with good results in experienced hands; convalescence is more smooth and less hazardous than after the classical procedure.

It is a more difficult operation than the classical, not only in gaining entrance to the uterine cavity, but also in the delivery of the child; the closure of the uterine wound is less difficult than in the Sanger method.

There is less loss of blood than is usual in the classical procedure.

The transperitoneal technique is to be preferred to the true extraperitoneal because of ease of performance, less interference with the bladder, and the avoidance of contamination of the retroperitoneal and preperitoneal tissue areas.

The preferable technique is the modified Veit-Fromme.

Subsequent pregnancy and labor are usually not influenced adversely; repetition of the procedure may be more difficult and in some cases it may be impossible.

The appended bibliography is by no means complete, but simply comprises a few of the more important papers on the subject which have appeared since 1907. It is interesting to note that in the year 1907 there were but four articles noted in the *Jahresbericht für Geburtshilfe und Gynäkologie*. Of these there were two by Veit and two by Frank.

## BIBLIOGRAPHY


FRANK. Arch. f Gynäk., lxxxi. Gesellsch. f. Geburtsh. u. Gynäk., 1906, May. Naturf.-Ver., Koln, 1907. Zentralbl. f. Gynäk., 1910, No. 6.

VEIT. Monatschr. f. Geburtsh., xxvi. München. med. Wchnschr., 1906, p. 1610. Naturf.-Ver., Koln, 1907. Wien. klin. Wchnschr., 1908, No. 35. Zentralbl. f. Gynäk., 1910, No. 16.

BAUMM. Gynäk. Gesellsch., Breslau, 1907. Zentralbl. f. Geburtsh. u. Gynäk., 1907, No. 14.

BUMM. Ztschr. f. Geburtsh. u. Gynäk., lxiii, No. 3. Monatschr., 1909, xxxii, No. 5.

CZYZEWICZ. Zentralbl. f. Geburtsh. u. Gynäk., 1907, No. 25.

FROMME. Berl. klin. Wchnschr., 1907, No. 4. Zentralbl. f. Geburtsh. u. Gynäk., 1907, No. 17.

HOFFMEIER. Zentralbl. f. Geburtsh. u. Gynäk., 1908, No. 29.

HOLZAPFEL. Ztschr. f. Geburtsh. u. Gynäk., 1908, lxiii, No. 2.

KUSTNER. Zentralbl. f. Gynäk., 1908, No. 16. München. med. Wchnschr., 1909, No. 34. Deutsche Gesellsch. f. Gynäk., München, 1911. Zentralbl. f. Gynäk., 1911, No. 27.

LATZKO. Wien. klin. Wchnschr., 1908, No. 20. Frauenarzt, 1910, No. 6.

PFANNENSTIEL. Zentralbl. f. Geburtsh. u. Gynäk., 1908, No. 10.

RUBESKA. Zentralbl. f. Geburtsh. u. Gynäk., 1908, No. 10. Zentralbl. f. Geburtsh. u. Gynäk., 1908, No. 17. Zentralbl. f. Geburtsh. u. Gynäk., 1909, No. 33. Zentralbl. f. Geburtsh. u. Gynäk., 1910, No. 35.

SELLHEIM. Zentralbl. f. Geburtsh., 1908, No. 6. Zentralbl. f. Geburtsh., 1908, No. 10. Zentralbl. f. Geburtsh., 1908, No. 20. Deutsche med. Wchnschr., 1908, No. 40. Hegars Beiträge, 1908, xxiii, No. 2. Beitr. z. Geburtsh. u. Gynäk., 1909, xiv. Gynäk. Rundschau, 1909, No. 16. Monatschr. f. Geburtsh. u. Gynäk., 1910, xxxii, No. 5. Monatschr. f. Geburtsh. u. Gynäk., 1911, xxxiv, No. 1.

DOEDERLEIN. München. gynäk. Ges., 1909. Monatschr. f. Geburtsh. u. Gynäk., 1909, xxiii. Zentralbl. f. Geburtsh. u. Gynäk., 1909, No. 4. Monatschr. f. Geburtsh. u. Gynäk., 1911, xxxiii.

DUHRSSEN. Berl. klin. Wchnschr., 1909, No. 5.

HARTMANN. Gynäk. Rundschau, 1909, No. 20. Gynäk. Rundschau, 1910, Nos. 22–23. München. med. Wchnschr., 1911, No. 58.

JEANNIN. L'obst., 1909, No. 8. Presse méd., 1910, No. 61.

OLSHAUSEN. Zentralbl. f. Geburtsh. u. Gynäk., 1909, No. 43.

RUNGE. Arch. f. Gynäk., 1909, lxxix. Berl. klin. Wchnschr., 1910, No. 36. Arch. f. Gynäk., 1910 lxxix, No. 2.

LEOPOLD. Arch. f. Gynäk., 1910, xci.

SOLMS. Zentralbl. f. Gynäk., 1910, xlviii.

WALCHER. Monatschr. f. Geburtsh. u. Gynäk., 1911 xxxiii.

ROEMER. Ztschr. f. Geburtsh. u. Gynäk., 1911, No. 68.

FRANZ. Prakt. Ergebn. d. Geburtsh. u. Gynäk., Wiesb., 1910, No. 4.

ULISZEWSKI. Wien. klin. Rundschau, 1912, No. 16.

VOGT. Arch. f. Gynäk., 1911, No. 95.

BAISCH. München. med. Wchnschr., 1911, No. 41 and No. 58.

TRAUGOTT. Monatschr. f. Geburtsh. u. Gynäk., 1911, xxxiii.

RICHTER. Monatschr. f. Geburtsh. u. Gynäk., 1912, xxxv.

LITSCHKUSS. Monatschr. f. Geburtsh. u. Gynäk., 1912, xxxvi.

# SOME CAUSES OF FAILURE IN BACTERIN THERAPY[1]

By J. FAVIL BIEHN, M. D., Chicago

THERE are many interrelated factors in the production of immunity, and numerous minute details requiring the closest attention, many of which, although apparently insignificant, are really the prime causes of failure. I have attempted to briefly outline and consider the commoner ones and those that experience has shown me are more frequently the cause of trouble with the average practitioner.

We may classify the causes of failure under the following general heads: incorrect bacteriologic diagnosis; improper bacterin, either stock or autogenous; improper dosage, either size of dose or interval between doses; and lack of proper concomitant treatment.

## FAILURES DUE TO INCORRECT BACTERIOLOGIC DIAGNOSIS

In some cases it is possible to make a diagnosis clinically, but as the action of bacterins is specific, it necessarily follows that an accurate bacteriologic diagnosis is absolutely essential. With the possible exception of cases of furunculosis, an attempt at a correct bacteriologic diagnosis should always be made. This may, however, be impossible, as for instance where we have a deep-seated abscess or where for other reasons it is not feasible to obtain the infectious material. Further, the material obtained may not show or contain the causative organisms or they may not be recognized, especially where there are several other organisms present. Through lack of bacteriologic knowledge and skill, the causative agent may not be correctly determined. Further, especially in chronic cases of the respiratory tract, the infection changes from time to time, and it is necessary to make frequent examinations and change the bacterin as the infection changes. Any of the above may result in an improper bacterin being given, and necessarily failure must result. This may all be summed up under the head of improper bacterin due to incorrect or impossible bacteriologic diagnosis.

## THE BACTERIN

1. *Stock bacterins.* The stock bacterin used may not contain the proper strain. This the manufacturers of stock bacterins have attempted to obviate by producing what are known as "polyvalent bacterins," i.e., a bacterin containing a number of strains of the same organism; but this is in reality only a makeshift, because if ten strains are used and only one of them is the proper strain, the dose given is only one-tenth of that particular strain, the other nine-tenths of the dose being composed of other strains and probably having no effect. While this may seem theoretical yet it is a practical fact. Further, the stock bacterin may not contain all of the bacteria causing the infection — may not be the proper mixture. It is advisable, therefore, in using stock bacterins to prepare your own mixtures. So far as is known, there is no definite disadvantage or objection, from a clinical standpoint, to using a bacterin containing additional varieties of bacteria, except that the patient's cells are called upon to produce antibodies to these additional bacteria, which are without any definite curative value so far as the particular infection from which the patient is suffering is concerned. It may, therefore, be considered as merely an additional tax upon the patient's cells without any direct, immediate benefit.

Failure may also result because a stock bacterin is not properly prepared. It may have been heated too high, so that its immunizing properties have been destroyed, or the bacteria originally used in the preparation of the stock bacterin may not possess immunizing powers. This we find is true in some cases in which old, avirulent stock cultures are used. The stock bacterin may be old, i.e., it may be overkept, as a result of which autolysis has taken place, and in certain infections this bacterin would be of no value, because recovery or immunity depends to a great degree upon the formation of lysins by the cells. If the bacterin has undergone autolysis, this response is not called forth. In certain other cases the bacterin may be underkept, or as we might term it, "green." Autolysis not having taken place, a sufficient amount of endotoxins have not been liberated, so that the formation of anti-endotoxins, the principal immune bodies in some infections, are not as speedily called forth as from the injection of an older bacterin of this same variety.

Again, chemical changes may take place in the bacterin, owing to the dissolving of alkali from the glass, especially if it has been kept under improper conditions, at room temperature. On

[1]Read before the Chicago Gynecological Society, June 27, 1913. (See discussion, p. 262.)

this account it is advisable to use Jena glass, and for this reason bacterins in ampules of Jena glass, or of the new Fiolax glass, which gives up even less alkali than the Jena glass, are to be preferred to bacterins in syringes, which are usually not made of Jena glass.

2. *Autogenous bacterins.* These may not be prepared from the proper bacteria, or the predominating organism may be one that does not grow very readily, and is, therefore, overlooked; or, the bacteria isolated from the infectious material may not possess immunizing powers, and further, the bacterin may not be prepared properly. It may be overheated, etc.

*Dose.* The dosage may be too small. We therefore do not get a clinical reaction, the negative phase and the corresponding positive phase are very brief, and the immunity does not rise very high. Such a condition does not produce the best results and may actually result in failure, owing to the fact that the stimulation applied is not great enough. Or, the dose may be too large, resulting in the patient's immunizing forces being practically exhausted, with the result that additional large doses cannot call forth a further response. This is to be obviated by careful clinical observation of the patient and the giving of only such a dose as will cause a very slight clinical reaction, not increasing the dose as long as it continues to produce this slight clinical reaction. The frequency of dose varies, of course, depending upon whether the case is acute or chronic, whether a large or small dose be given; failures frequently result from the improper spacing of the dose. Especially large doses should not be given at short intervals. The attempt to produce a summation of positive opsonic phases is the ideal one; and the production of a summation of negative opsonic phases is to be avoided, as it usually results in failure.

*Lack of proper concomitant treatment.* Lack of proper concomitant treatment has, in my experience, been the cause of the greatest number of failures, at least so far as it has occurred in those cases in which a proper bacterin was used. We may divide this concomitant treatment into general and local. General treatment consists in the proper control of the eliminative organs — renal and intestinal. Constipation, intestinal indigestion, and fermentation produce toxic poisons that have an antiopsonic effect, and their formation and absorption must be prevented. Further, the toxins produced by the infectious agent are destroyed by the spleen and the liver, and are eliminated by the kidneys, skin, and intestines. The intestines are also known to eliminate bacteria, therefore we must keep all of these organs in the best possible working order. One can readily understand that the cells of the body and the organs of elimination may be overtaxed in combating the absorption of fæcal toxic products, or at least so occupied that there is no reserve force capable of being stimulated by the injection of bacterins. Under general treatment also comes the treatment of general diseases other than the infection. We are always to search for certain constitutional diseases in every infection. An example that is familiar to all of us is the tendency to furunculosis in patients with diabetes. The mere injection of bacterins in these cases usually results in failure, and it is only by careful attention to and treatment of the diabetic condition that results may be hoped for. Further, in certain diseases, such as leukæmia and leucocythæmia, the leucocytes possess very little phagocytic power, and it is possible that although you may produce a high opsonic index in patients with these diseases, recovery will not occur, owing to the inefficiency of the leucocytes.

Local treatment aims at removing foreign bodies and sequestra harboring the infectious agent, otherwise continued reinfection occurs. Healing will not take place as long as there is an infected foreign body in the tissues, so that surgical measures wherever indicated require prompt attention. Then, we may have a high opsonic index content of the general serum, but the local circulation may be sluggish, or owing to local high pressure conditions, the opsonins may not have access to the local lesion. This is to be remedied by free drainage, or such measures as tend to produce a local hyperæmia — the use of hot fomentations, Bier's hyperæmia, Finsen light, manipulation, massage, etc. These, of course, will all tend to produce auto-inoculation, and in certain cases are to be avoided. Especially is this true in tuberculosis. The patient should be placed in bed at absolute rest, as exercise results in auto-inoculation, which, if continued, will have practically the same effect as a too frequently administered dose of bacterin.

The local use of antiseptics must be governed by the following rules: a sufficiently concentrated germicide must be used to destroy all of the bacteria, leaving a sterile site, otherwise the destruction of tissue will merely augment the further action of any bacteria that have not been destroyed; or, a mild antiseptic may be used, sufficient to inhibit the multiplication of the bacteria but not sufficient to destroy the tissues. Preferably, antiseptic solutions are to be sup-

planted by the use of Wright's 5 per cent sodium chloride, sodium citrate solution. This prevents coagulation and augments osmosis, thereby promoting the flow of lymph with its increased opsonin content. The lymphatic circulation may also be enhanced by the administration of citric acid, 30 to 60 grains three times a day, as advised by Wright.

There still remains a possible cause of failure in the lack of a sufficient number of active leucocytes. Exactly how this may be remedied is not yet definitely known. We can increase the number of leucocytes by the administration of nuclein, sodium cinnimate, pilocarpine, or salicylic acid, but we have no knowledge or direct evidence to prove that the phagocytic power of these leucocytes is normal. Personally I have used nuclein with apparent clinical success. This seems to me to be the most rational of the drugs mentioned, as it is a constituent of the leucocytes themselves.

Failure may possibly also result from an improper selection of the site of injection. Our present knowledge would indicate that subcutaneous or intramuscular injections produce the best results. Wright and Allen do not believe that intravenous injections are of value. They reason that the blood is not actively engaged in the production of antibodies, therefore the circulating streptococci in septicæmias do not result in the production of immunity. That this is not a general rule, however, and will have to be definitely worked out for each organism, has been proven recently by the fact that in contagious abortion of cattle the best results are obtained by the intravenous injection of the bacterin. Whether this holds true for any other organisms, we do not yet know.

There are some cases in which failure results for reasons as yet unknown. It is very evident that all infections, or all persons, irrespective of their infection, are not amenable to bacterin treatment. Some are incapable of responding. Bacterins will not produce a cure in all cases, and the tendency of the times, owing to the apparently wonderful successes, is toward overenthusiasm. We are repeating with bacterins the history of tuberculin — using them for everything, irrespective of the indications, and usually with a free hand, often without any definite reason, and in any disease, whether it be a proven infection or not. Cases are being reported of wonderful success; very frequently the number of cases is not mentioned, and the average clinician, without opsonic or bacteriologic control, is using any bacterin, in every sort of disease, and reporting wonderful results in one or two cases. He becomes overenthused, and passes this enthusiasm on to others, but many times they are doomed to failure. This is a very unfortunate condition, for bacterins are of value, if thoroughly understood and rightly used, and do produce results in many cases that are nothing short of wonderful. I sincerely hope that before long they will be sufficiently understood, their indications and limitations known and recognized. They will then obtain and maintain their proper place in therapeutics.

---

## NEW APPLIANCE FOR THE INTERNAL FIXATION OF FRACTURES OF THE FEMORAL NECK

By M. E. PRESTON, B. A., M. D., Denver, Colorado

FRACTURES of the neck of the femur, for years, have been among the most difficult we have had to treat. Operative intervention in these cases has not been satisfactory because of the difficulty of holding the fragments in position even after they have been exposed. The reason for this difficulty is most apparent if we study the internal structure of the upper end of the femur. The illustrations of sections of the upper end of the femur (Figs. 1 and 2) give a good idea of the relative disposition of the compact and cancellous tissue in the femoral neck.

When, during operation, reduction is temporarily accomplished by traction and manipulation, and an ordinary screw is driven through the trochanter and neck, the fixation thus accomplished is practically worthless. As soon as upward traction is exerted on the shaft by the heavy muscles of the thigh and hip, the cancellous tissue on which the screw takes its hold, crushes, and the usual deformity follows (Fig. 4.) A röntgenographic study of the cases operated on in this manner will show the inefficiency of securing the fragments by this method. It is granted that

good results have followed this operation, but I am satisfied that in most instances they have been due more to the action of a properly applied Buck's extension during the after-treatment than to the securing of the fragments by means of the ordinary screw or nail. The essential reason for this failure in fixation is due to the fact that the ordinary screw or nail used for this purpose secures its hold only in cancellous tissue.

To obviate this difficulty I have devised a screw-plate which secures its hold on the compact tissue below the great trochanter and will maintain the normal angle of the neck in spite of the action of the thigh and hip muscles. It is a combination of a screw and a plate in one piece. The screw portion is of the ordinary wood type and is made in varying lengths while the plate part is fashioned after the Lane plate. The screw portion joins the plate at about 110 degrees, which is less than the angle at which the femoral neck joins the shaft. This difference is due to the fact that the surface of the shaft just below the trochanter is not parallel with the axis of the femoral shaft, and since the plate secures its hold

Fig. 1. Coronal section of upper end of femur showing the relative disposition of compact and cancellous tissue.
Fig. 2. Section of femur corresponding with the line A–B in the preceding figure.

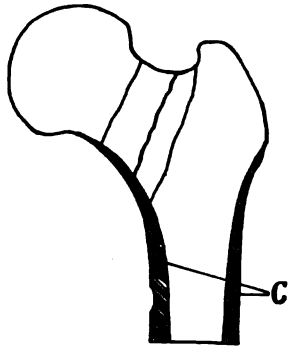



Fig. 3.

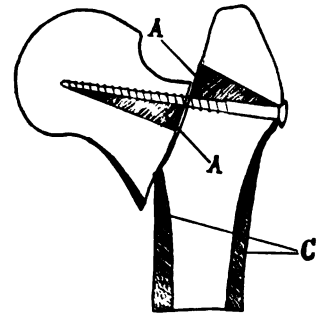



Fig. 4.

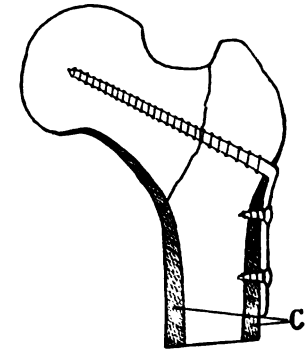



Fig. 5.

Fig. 3. Diagram of femur showing the common sites of fracture of the femoral neck.
Fig. 4. Diagram showing the manner in which the cancellous tissue crushes when the neck is subjected to the displacing action of the thigh and hip muscles, following operation with a simple screw or nail.
Fig. 5. Diagram showing the author's screw-plate in position. Angulation of the screw portion is prevented by the plate portion which secures a firm hold on the only available compact tissue in this region.

on this portion of the bone, the angle has been adapted accordingly.

The length of the screw portion varies with the size of the bone and the position of the fracture. When the break is near the inner end of the neck, the screw should extend well into the head of the bone. When the fracture is situated at the base of the neck a shorter screw will accomplish the desired fixation. A number of sizes should be at hand so the surgeon may select the proper length.

The angle at which the plate joins the screw is such that the plate clears everything as the appliance is being screwed into position. Before the screw is entirely driven home the plate should be bent with pliers so it will fit the surface of the femur with which it will ultimately come in contact.

I have not as yet used the appliance in a sufficient number of cases to give a report which would be particularly valuable or conclusive, yet the mechanical fitness and ease of application of this screw-plate have demonstrated its value, pending a further report.

# TRANSACTIONS OF SOCIETIES

## CHICAGO GYNECOLOGICAL SOCIETY

A REGULAR MEETING WAS HELD JUNE 27, 1913, WITH DR. FRANK W. LYNCH IN THE CHAIR

### CARCINOMA OF THE APPENDIX

DR. EMIL RIES: I have some rare specimens that may interest the members. The first one is a case of carcinoma of the appendix. It is the first one I have had, and I want to say I got it entirely accidentally. I opened the abdomen of this patient, a woman 40 years of age, on account of chronic salpingitis, with adhesions, and we supposed that her intestinal difficulty, constipation and so on, were due mainly to the adhesions. When we opened the abdomen, freed the adhesions and removed the pus-tubes, which she had, I looked at the appendix and found a perfectly solid structure. This appendix is cut open in several places and you can see on the cut-surface how the muscular coat of the appendix is contracted, and the center of the organ is solid and is protruding through the sheath of muscular tissue. This is entirely different from what we are accustomed to see in cases of obliteration of the appendix, and the feel of the appendix should immediately tell us this is not an ordinary obliterated appendix. The ordinary obliterated appendix, when it is cut open, shows a tendency to retract in the center because the slight amount of cicatricial connective tissue that forms there is more liable to draw back than to push out. Here the center is pushed forward. It evidently is under more or less pressure. It was clear this woman had something different from the ordinary obliteration of the appendix, and the microscope confirms the diagnosis of a malignant neoplasm.

It is not absolutely certain whether it is an adenocarcinoma or an endothelioma. There are few traces of lymphoid tissue. The rest of the appendix, except the muscular coat, is taken up by a net-work and a mesh-work of epithelial, or epithelioid, cells which are arranged in files of one or two; then they run together in large masses of cells, and these larger masses contain vacant spaces or vacuoles which remind one of the formation of endothelioma. I have placed under the microscope one part of the appendix which shows this mass of endothelial neoplasm very distinctly.

I have made dozens of sections and find in various parts of the appendix that the endothelial neoplasm apparently does not reach outside of the muscular coat. It is found within the muscular coat completely. It is not the nature of carcinoma to respect the muscular coat in any way. It is the nature of carcinoma to break through it. I found a number of sections in which the carcinoma had broken through the muscular coat and was in the serosa of the appendix. I have sections which show the carcinoma in the serosa of the appendix.

Carcinoma of the appendix occurs in two forms: one the solid form, and the other the form in which a large amount of mucus is produced. You doubtless remember the case of Dr. Watkins, which was in the shape of a cyst. That cyst proved to be a carcinoma of the appendix, with the production of so much mucus that it had distended the appendix. These are the two forms, the present case being the solid form in which you can see solid masses of neoplasm very distinctly.

Here is the carcinoma in the serosa. As far as one can tell in the living, I have investigated the gall-bladder and stomach and intestines as far as I could, and there is no tumor anywhere else. I removed the appendix without leaving any stump. I excised the appendix at the cæcum, made a fair sized hole in the cæcum, and sewed up the hole and extirpated the whole structure. The patient has had no return or trouble of any kind.

Cases of carcinoma of the appendix are interesting in this particular, that the tumor is rather benign. There are a considerable number of cases on record in which surgeons have gone into the abdomen and accidentally found carcinoma of the appendix. This woman had no symptoms of appendicitis or of any tumor. There are no metastatic glands anywhere. She is in perfect health so far. The operation was done five months ago.

### STRUMA OF THE OVARY

DR. EMIL RIES: I have here another specimen of a case of struma of the ovary. I removed from a woman an ovarian tumor of large size, which was filled with colloid material which contained apparently one cyst. In the wall of that cyst was one rather hard nodule the size, I should say, of a 50-cent piece, and it was about one-half inch thick. Sections through the thin part of the cyst showed nothing but an ordinary thick wall, and I found no epithelium on it, as we do in so many cases when the cyst has been very much stretched. But in the solid part I found a peculiar condition. I found the solid part to consist, first of all, of a material which in the hardening process coagulated to the consistency of almost celluloidin, and it appeared like the colloid of the thyroid gland. When we made the sections we found it was typical thyroid gland, the normal epithelium of the thyroid, but the colloid in the alveoli of the gland is of various kinds. You know that the colloid of the thyroid gland does not always stain the same way in the same gland. Some parts take more of the eosin stain, and some more of the hæmatoxylin stain, and with Van Gieson's stain we get various colors; this was true of this gland. In certain larger cyst-cavities of the more solid

portion of the tumor we found longitudinal slits which are characteristic of cholesterin which has been dissolved out in making the celluloidin preparation. The microscope shows the typical thyroid structure and the thickness of the tumor-wall. The last gland I removed from the neck. How does the thyroid get into the ovary? The simplest explanation is that there is a growth of the thyroid the same as there is a growth of other derivatives of cells which by an error of development get into the ovary. In all these cases we had to examine carefully to see whether there were any other structures except that one in the ovary, in order to characterize the tumor as embryonal or the derivative of more than the germinal epithelium. I have examined a considerable number of sections of this tumor, and I have found nothing else except thyroid tissue. Of course, when we find thyroid tissue, the next thing to look for is cartilage of the bronchial tree. We found no cartilaginous cells. There is no structure except thyroid tissue. There is nothing of any other organ, so that we have here one of these rare cases. There are twenty on record, all developing in one organ, only in an aberrant way and in an abnormal locality. This is a parallel case to the case of another practitioner, in which a single tooth was found in the ovary. In that dermoid structure there was just one tooth. In the same way just a thyroid gland developed here.

The two specimens, the one from the ovary and the other from the neck, show the thyroid tissue and cholesterin in the same field. This development of cholesterin in the colloid of the thyroid is nothing peculiar to the ovarian stroma. It is found in the stromas of the neck as well.

I have a number of thyroids which I have removed which show this development of cholesterin. In one case in which I found it more than in any other the patient had a thyroid fistula. This fistula led down to the thyroid gland, and had developed after an attack of typhoid fever. The patient had typhoid fever, and contracted an infection of the thyroid from the typhoid. A doctor opened up his typhoid strumitis, and evacuated a large amount of pus, but the abscess-cavity did not close. He had a discharge from the cavity. We took some of the discharge from the thyroid, made a Widal test and found it was positive. This cavity contained bony calcified masses, such as those described in Kocher's paper; and, as all these fistulæ are arranged, this fistula extended downward, and that is one of the reasons why it did not close. The deepest part of the fistula existed when the man was standing up. The thyroid was dissected away from the spinal column and extended to the side of the œsophagus. I injured the jugular vein and the thoracic duct. It was all one mass of adhesions and fibrous tissue. The thoracic duct discharged the customary amount of milk for five days, and then the patient got along all right. In that thyroid there was a vast amount of cholesterin. In some cavities, if you open the thyroid, you can see the cholesterin glisten. If you shake the fluid you can see the light reflected in these cholesterin crystals.

### DISCUSSION

DR. JONES: Do you not consider it very important to make sure of the diagnosis as to whether it is endothelioma or adenocarcinoma, as having a bearing particularly on the prognosis? Usually it is better to determine which it is.

DR. RIES: I do not believe that we can say there is very much difference in the malignancy of endothelioma and the malignancy of adenocarcinoma. I think it is six of one and half a dozen of the other. At first, one would say this is a carcinoma, until you have examined the specimen and found vacuoles, perfectly round, without mucous secretion. You are reminded more of an endothelioma than an adenocarcinoma. I think it would be rather fruitless to quarrel over the differential diagnosis. I would rather leave it to a better pathologist than I am. As far as the prognosis is concerned, I do not see that there is much difference.

DR. JONES: Zeit and others hold that endothelioma is not so malignant as carcinoma; that it occurs locally and metastasis occurs late, which is not true of endothelioma, particularly of the lymphatic type.

DR. RIES: A case in which I saw the largest amount of metastasis was one of endothelioma of the uterus which Zeit described in his paper on endothelioma. That case had enormous metastases, in such incredible locations and in such enormous amounts, that it was an exceptional instance. The microscopic slides proved it was an endothelioma of the uterus. There was no ulceration but there was hæmorrhage. An exploratory incision was made into the cervix, in which we found endothelioma. The patient did well. She went on a trip to Europe, and four months after she left the hospital I got a letter from her from Naples stating that she had rheumatism in the knee. The attack of rheumatism spoiled her trip. She returned to America. After her return, in getting out of bed she broke her thigh, leaving a large bony tumor sticking out at the hip. This woman soon showed local recurrence, especially in the bladder, and died in less than two years after operation. She was a mother and the wife of a physician and understood the value of post-mortem examinations, and left word with her son that I was to be notified when she died. I was notified within half an hour after her death. I made a post-mortem examination. This woman had metastases in various organs of the body. She had in the upper end of the vagina one mass of tumor which had broken through into the bladder. The pelvic connective tissue was one tumor-mass. The tumor involved the wall of the rectum. The large so-called bony mass that stuck out at the hip was an enormous carcinoma of the sciatic plexus as large as a fist. I have a section showing endothelioma between the nerve-fibers. The femur was not broken. I cut the femur open. There was no fracture of the femur. She had metastases in the kidney and spleen. The liver weighed 8 pounds. She had metastases in the adrenals, in the lungs, the pericardium, and the retroperitoneal glands. In short, there was

not an organ in the body that did not have some metastasis. We do not see endotheliomas frequently. They are comparatively rare in comparison with carcinomas.

### CHORIONIC VILLI

DR. RIES: A few weeks ago I showed sections and a gross specimen of a case which I diagnosed as chorionic villi remaining in the uterine wall eighteen years after the last labor. For those who were not present at the time I may recall a few facts. This woman had a fibroid tumor. I operated on the fibroid and removed it by supravaginal amputation. The operation was not attended with any difficulty whatsoever. When I was through with the operation I proceeded to investigate the specimen and noticed on the cut-surface, where the body of the uterus was cut away from the cervix, a whitish string hanging out of the cut-surface. Following up this whitish string I found it extended into a vein, and found that this vein extended to the length of from two to six inches, so that the upper end of the string was in a vein in the right uterine horn when the cut-surface was that far away from the right uterine horn. In cutting through the uterine wall I found other veins filled with smaller white strings, and on grasping some of these strings with tissue-forceps I found I could pull them out in a sort of bunch, like grapes, which reminded me of chorionic villi. I made microscopic sections which showed the shape of the white strings which filled the vein, and found them to be composed of chorionic villi, round, elliptical, branching, ramifying. This substance consisted of fibrous tissue with blood-vessels, the blood-vessels containing blood-cells the same as the rest of the uterus contained. The epithelium was covered with these villus-like masses. The endothelium lay flat. Each villus was apparently attached to the wall of the vein in some way, and where it was attached to the wall of the vein it perforated the wall of the vein, rupturing the circular muscular coat and penetrating the surrounding tissue. This tissue showed more or less homogeneous fibrous structure going through the vessel-wall into the uterine section. When I showed the sections at a previous meeting some of the gentlemen differed. One could see a double layer of epithelium. Another one could see syncytium. I could not see that. I still have been unable to find any syncytium. I wish I could find syncytium; then there would not be any doubt of these things being chorionic villi.

I did not say anything about what had been found in the literature regarding similar structures in certain cases of chorio-epithelioma. Dr. Robert T. Frank, of New York, wrote me a letter raising the question as to whether it could be proven absolutely that these were chorionic villi, or if it was not possible this was one of those comparatively rare cases of "vein myomas." He himself had a case of chorio-epithelioma in the testicle of a man in whom these white masses had grown into the mass and filled the veins to a greater or less extent. This structure is not distinctly that of chorionic villi the same as in my case, because there was no distinct syncytium covering the apparent villi.

What is to be said in favor of the idea that these things are villi? First, their shape. What may be said against the idea that they are villi? First, the remarkable length of some of these clefts. Who has ever seen a villus that long? Of course, it is possible that this long string which I found in one of the veins was not one villus but a whole villous tree, which became squeezed into the vein, the lateral branches of which were partially obliterated, so that this is the original part of the chorionic tree.

I am rather inclined to think the idea of calling these things "vein myomas" gives us an easier explanation, especially for these very long ones. The chorionic villi which were attached to the wall of the vein showed perforation of the vein circumference, and the circular layer of muscular tissue forming the vein in such cases is against the nature of these things being "vein myomas" because "vein myomas" originate in the muscular layers of the vein. Until we have a definite characteristic of the difference between "vein myomas" and chorionic villi remaining in the vein, the matter must be left in a state of suspension.

As I have said, I have not been able to find syncytium, which one of the doctors believed he saw, and until I recognize the force of the conclusion that such formations may be due to "vein myomas," we must regard the matter as uncertain. However, until the matter is cleared up we must leave the case reported in the literature as one of chorionic villi remaining in the uterine wall eighteen years after the last labor. I have considered it my duty to make a report in which I mentioned Dr. Frank's letter and the importance of this discussion of this case.

### DISCUSSION

DR. FRANK A. STAHL: Dr. Ries has brought out the point that he was not able to find syncytium in the specimen that he presented at a previous meeting of the society. Dr. Webster was rather inclined to the opinion that this was one of the points of differentiation, and that this specimen showed the development of chorionic villi characteristic of a certain period. This is a familiar subject, and we all know that in the later months of villous development we have the absence of syncytium, so-called. I presume it is called syncytium from the so-called immediate action of the cell in its environmental tissue. Later on in its development the muciparous limiting stroma disappears more or less and you have practically a granular limiting membrane, which I do not think is a limited membrane, but which is merely muciparous stroma mixed from the absorption of the granules. Its surrounding tissue is broken down by the amœbic action of Langerhans nuclei or cells. In the specimen we still

have these brown granules which are characteristic of syncytium.

I would like to call attention to the fact that in the specimen exhibited that evening there was a limiting structure which was characteristic of syncytium so-called.

As regards the length of development, in the report of a two weeks' specimen of extra-uterine pregnancy I showed a villus which extends from this small chorion down to the inflammatory exudate in the ampulla of the tube. Instead of developing in the nature of a string-condition of the villus, which is characteristic of villi in cases of extra-uterine pregnancy, where you have a club-shaped, juicy, rapidly growing expression of the root, there we had a string-like formation. It was impossible for us to obtrude upon the generosity of the editor, otherwise I might have presented a case of chorionic villus in that small type of gestation which would apparently approach the suggestion Dr. Ries has made here this evening. It was a long drawn out string, but as it was only a two weeks' pregnancy I removed it at the end of 8 or 9 days. As a comparison, it would be favorable to Dr. Ries' string of the same order, and it grew in a perpendicular rather than in a longitudinal direction instead of budding out in all directions.

As regards the venous myoma structure, I think we had better leave the subject just as Dr. Ries mentioned it, but the specimen surely presents a villous development such as we suggested the other evening.

It is gratifying to me, Dr. Ries, that all your work would seem to be confirmatory of the suggestion I made in my work at that time, not thinking it would be possible to have it confirmed by a member of our society. In my reprint I showed you the nuclei, the external layer wandering into all coats of the tube.

### THE PERSISTENCE OF GONORRHŒAL ARTHRITIS IN THE PRESENCE OF CHRONIC GONORRHŒAL INFECTION IN THE FEMALE GENITALIA

DR. D. B. PHEMISTER: Both of the cases I wish to report are instances of joint-infection, one gonorrhœal and the other tuberculous. I will present the first case of gonorrhœal infection. The patient was a female, eighteen years of age, who has had trouble with her joints for eleven years. When she was seven years of age, she was taken with rather acute symptoms in the right knee-joint, followed by an effusion into the joint; and this developed into a chronic condition which persisted for about a year. Finally, a diagnosis of tuberculosis of the joints was made and the patient was treated with a plaster of Paris cast for two years. Then from about the ninth to the fourteenth year she had recurrent attacks of effusion into the joints and was on crutches most of the time. From the fourteenth year on, for the last four years her right knee-joint did not bother her very much. It became rather quiescent, but there was considerable stiffness in the joint. Three years ago the left joint became involved, and during the last three years she has had repeated attacks of pain in the joint, followed by a marked serous effusion and pain which kept her off of her feet three or four days at a time. She would improve, and after a few weeks the effusion in the joint would disappear to be followed by a recurrence. An examination of her at the time showed in the right knee, which was involved for eleven years, a moderate amount of thickness about the joint. There was a restriction of motion to about one-half in the joint, but only a small amount of tenderness on manipulation. Examination of the left knee-joint showed a very marked deviation and just mild inflammatory signs in the joint. The first thing I did, after making this physical examination and finding evidences of chronic arthritis in the joints, was to have X-ray pictures made of the joints. From the X-ray plates I was able to see that almost certainly the process was due to gonorrhœa. I want to show you these plates of the left knee, where the process was only of three years' standing. They showed practically no changes in the bones. The plates of the right knee show no local atrophy, but they show an undermining of the cartilage of the epiphysis of the tibia. This is a finding which is quite characteristic of either. It is a condition which, when we find it, is nearly always due to either tuberculosis or to gonorrhœa; and in addition to this undermining of the cartilages on the sides there was an arrested growth of the epiphysis in its anteroposterior diameter. This arrested growth is due to the fact that there has been a chronic arthritis, with restriction of motion, and the limb had not gone through the normal range of motion, and for that reason was not more than one-half as thick in its anteroposterior diameter as it should be.

These lines on the side are practically always due to either tuberculosis or gonorrhœa. If this was due to tuberculosis, there would be extensive destructive changes there. The fact that the left knee was not involved after three years practically rules out tuberculosis, because there would be extensive destructive changes there in that case.

After this physical examination and the X-ray examination, I felt practically sure the trouble was due to gonorrhœa, and I got some more of the history. I found that when the child was six and a half years of age she developed a vulvovaginitis, and within six months afterwards the right knee became involved. I got a history that with every exacerbation in the joints, even before puberty, she would have leucorrhœa. As the general condition quieted down the leg would improve, but sooner or later there would be a recurrence of the trouble. Since puberty she has had more leucorrhœa, with the joint-attacks, and she has also had occasional attacks of pain. Last fall she had two attacks of what we diagnosed as appendicitis. Then I made a pelvic examination. I found a mass to the right of the uterus. As it was nothing that I could feel I left it. Then I called in Dr. Irons, and he made a series of laboratory tests. He made the fixation test, the allergic reactions, and got a positive skin reaction to the gonococcus but a negative one of all the other organisms. He examined the blood, and a Wassermann was negative, but there was a complement-fixation for the gonoccocus. He tapped the knee-joint and got a serous fluid from which he made cultures and recovered the gonococcus from the knee-joint. That verified the diagnosis. The child had had gonorrhœal pelvic infection when six and a half years of age, with involvement of the right knee-joint lasting for eleven years. The involvement of the left knee-joint began eight years afterward and lasted up to the present time.

The interesting features about the case are the persistence of the joint-infection and the inter-

mittent recurrence or intermittency of the process in the joints.

Another interesting feature was the late involvement of the left knee-joint; then the presence of a tumor-mass in the pelvis. In gonorrhœal infections in children, involvement of the tubes leaving a mass is very unusual, and it is a question if the tubular involvement is not a recent condition, either due to a lighting up of the old infection or possibly to a secondary infection, that is, of an acquired gonorrhœa in the last year and a half or two years. The patient gives no history suggestive of this, but it may be in the same way that the joints light up, so may the pelvic process occur, thus causing this tubular involvement of the right side. The persistence of the process in the knee-joints is, in all probability, due to the fact that the pelvic condition has never cleared up. If the pelvic condition had cleared up in all probability the process in the joints would have disappeared long ago. We know that this is the case with metastatic gonorrhœal infections in other locations, and it is the case in the male. A chronic gonorrhœal prostatitis is responsible for the persistence of gonorrhœal arthritis and for the recurrence of the process in the same way in infections of the uveal tract and of many other locations.

I think the ideal treatment, if we could have carried it out, would have been to remove the adnexa; but it is a question if removing the tubes alone would have been sufficient. Probably a panhysterectomy would have been necessary to get rid of the pelvic infection, and then the gonorrhœal arthritis would, in all probability, have cleared up.

The second case I will relate briefly to show the comparative value of the laboratory findings in the two cases.

The second case was a twenty-three year-old Polish woman from whom we got a very imperfect history. She was married at the age of eighteen. She had had no miscarriages and no children. Seven years ago she was taken with arthritis of the right knee-joint and has been bothered with it ever since. In this case the process is much more severe than in the other. She has been on crutches most of the time. Two years ago she developed abdominal and pelvic symptoms, the exact nature of which we did not ascertain. She was operated on at the Cook County Hospital, a laparotomy being done. She came to us complaining of the knee. She was on crutches. She had a stiff and swollen knee, and also pelvic pain. Examination showed a very much thickened knee-joint, with a small amount of effusion, and an X-ray examination of the joint showed that very destructive changes had taken place. It is easy to see the striking difference between the joints in this case and in the other due to gonorrhœa.

The semilunar cartilages are entirely destroyed. The cartilage of the ends of the bones is destroyed and there is considerable destruction of the bone itself. There is marked local atrophy, so that the X-ray findings in this case seem to indicate tuberculosis. The pelvic examination showed the uterus to be retroverted, with a firm tumor on the right side. Dr. Irons made laboratory tests in this case. The skin-reactions were negative. I will say that the von Pirquet was not made, unfortunately, but for the gonococcus and all of the other organisms the skin-reactions were negative. All of the blood-reactions were negative. There was no Wassermann, no complement-fixation of the gonococcus. The fluid from the knee-joint showed nothing culturally.

On the strength of these findings we made a diagnosis of tuberculosis of the knee-joint, and the diagnosis as to the pelvic condition, while it was not positive, was supposedly a tuberculous process.

Dr. Heaney opened the abdomen and found tuberculosis of the tubes, ovaries, and of the endometrium and a healing tuberculous peritonitis. The knee-joint was resected and we found very extensive tuberculosis of the knee-joint in the ends of the bones.

As in the other case, the process started in the pelvis and extended to the joints and persisted in the joints because of the persistence of the process in the pelvis. The process in this case started in the right knee-joint, persisted for years, producing very extensive changes, and then gave rise secondarily to a tuberculous peritonitis of pelvic involvement. It was the reverse of the other condition. While the pelvic condition in the other case gave rise to joint-involvement, here a neglect of the general condition gave rise to pelvic involvement.

I will show you the specimens of tuberculosis of the knee and tuberculosis of the genitalia.

Microscopically there is involvement of the endometrium, complete destruction of the mucosa of the tubes, which is fatal with tuberculous disease, and then the process in the ovary was just a typical tuberculosis. There was no involvement of the muscle of the uterus in this case.

### DISCUSSION

DR. ERNEST E. IRONS: An interesting feature in this case was the recurrent character of the

arthritis. It is true that in these cases the arthritis was not recurrent at any definite period of a certain number of days or weeks, but in other ways the case was similar to the one which has been called intermittent hydrops of the knee. There are recurrent attacks of arthritis, swelling, effusion, temporary disability, leaving a relatively intact knee, such as one sometimes notices in an intermittent hydrops in which practically the only difference clinically is that in the intermittent hydrops we have a definite cycle or day.

We had recently another case of true intermittent hydrops with a ten-day cycle in which we were able to study the various reactions of the blood and skin, and in which in one of the recurrences of the hydrops we were able to isolate the gonococcus. I know that there are many cases probably of intermittent hydrops that are not due to the gonococcus; but from a study of three or four cases we have been able to make in the last four or five years, of gonococcal origin, it would seem that a considerable proportion of the intermittent hydrops cases are really of gonococcal origin. In this particular case of intermittent hydrops we were able to make out that there was a very definite cycle of immunity which had a definite relation to the occurrence of arthritis. We know that if we inoculate a case of tuberculosis with tuberculin we get quite a marked reaction of the skin. The same is true to a less degree of certain other infections, including preparations made from the gonococcus. If we had a suitable extract of gonococcus and inoculated it under the skin, we would get, in a case of gonococcal infection, a certain degree of reddening of the skin in much less degree than in the ordinary von Pirquet, but having a definite character. Applying that test to intermittent hydrops, you get a very definite variation in the degree of skin-reaction from day to day. Two or three days before the recurrence of the attack you get practically no reaction, and then a little later, after the attack has occurred and the knee is full of fluid, you get an increased reaction, so that the reaction now is three or four times as great as during the low period. If we take the blood from such a patient every day and test it for the complement-fixation for gonococcus, we get the same period of low activity. A little later, when the joint appears to get better, we get a positive complement-fixation, and these reactions can be shown to follow a definite cycle corresponding to the recurrent cycle in hydrops. These findings possibly explain why we have recurrent hydrops. It is a question of immunity of temporary character which is stimulated by the recurrence of arthritis and subsides promptly. Such a view fits in with the clinical cases of gonoccocal infections. One attack does not protect against another attack. The cycle of immunity is there and is short, and these laboratory findings confirm that view. It is characteristic of gonococcal infection. It is quite different from what we have in typhoid fever, where the immunity develops more slowly.

As far as the diagnostic value of the complement-fixation test is concerned in these two cases, and judging from painful experiences in a large number of other cases which have been proved clinically, we should feel that the complement-fixation test in cases of gonococcal infection is unquestionably of decided value.

So far as the cutaneous test is concerned, it is of great value in tracing the curve of immunity. It probably will never be of great value from the standpoint of diagnosis, because the number of exceptions must be considered.

DR. JOSEPH BIEHN read a paper (by invitation), entitled "Causes of Failure in Bacterin Therapy." (See p. 258.)

DISCUSSION

DR. IRONS: I would like to emphasize the last paragraph of Dr. Biehn's paper as to the indiscriminate use of the attempt to cover all forms of infections by specific therapy, and to say that such a method is in great danger of bringing this form of therapy into entire disrepute. It is a method that any of us feel has definite possibilities and still greater opportunities for the future, but requires careful study on the part of those who are using bacterins.

A MEMBER: I would like to call attention to the use of nucleinic acid. We tried it in a number of cases and watched the leucocytosis to see if we got any reaction from it; and I would like to ask the author of the paper if there have been any further laboratory contributions showing that nucleinic acid is of value, not from a clinical standpoint, which is sometimes misleading, but from the standpoint of laboratory tests, either by examinations of the number of leucocytes or by their activity.

DR. RIES: Perhaps this is an opportune time to try to elicit a little discussion among the members and guests as to their experience with a certain new product which is very actively advertised and more or less discussed in the periodicals but which is not really a bacterin, but for which the most marvelous results have been claimed. I am speaking of so-called phylacogen. If there is any grain of truth in the vast amount of advertising literature that is being put out regarding this agent, I should like to have it tested.

It is claimed that the preparation of these phylacogens is not secret. It is claimed that it is positively demonstrable as to what goes into these phylacogens. The theory on which the treatment is built up is entirely fanciful. There is no scientific foundation for it. I cannot understand how anybody with any regard for his scientific conscience can be willing to use such a "gunshot" prescription as these phylacogens are. Nevertheless, we hear of such wonderful successes from the use of phylacogen in certain diseases — and I would mention especially rheumatism and pneumonia — that it would be very interesting, aside from all possible theoretical foundations, to know how much of actual clinical facts have come to the knowledge of the members of this society. I regret I am unable to make up my mind to experiment with this drug, this mysterious substance, but I have been an interested spectator in at least one case of puerperal pyæmia in which a friend of mine gave phylacogen to the patient in the way advised by the firm preparing the substance; and I wish to state that the outcome of that case was in no wise different from the way these cases usually end. That is to say, after the patient had a considerable number of chills, and then phylacogen was administered, and she had some more chills, and phylacogen was then discontinued, and she had some more chills, she ultimately got well the same as we see any other cases get well that have had no treatment at all except alcohol, or hot or cold baths, or no douches, or some douches. In other words, without any treatment, I would like to know if any of the members have had experience with phylacogen. I would like to hear from any member, and particularly from some one who has had a negative experience. We all know the opsonic treatment of puerperal infection has been a sad failure. I do not know of any series of cases treated according to the Wright method that show in any way anything better than we can accomplish by ordinary nursing. I do not know of any series of cases in which any of the modern bacteriotherapeutic methods have given any better results than we usually accomplish to-day with ordinary nursing methods.

This is a subject of the greatest importance in view of the utter impotence which characterizes the eminent gynecologists and obstetricians in the presence of cases of puerperal sepsis, and it would be most desirable to make use of some of the successful methods of these modern investigations. If any one has had success I wish he would speak out loud and tell us. Speak of his failures, so that we may confirm our opinions.

DR. BIEHN (closing): As to the use of nucleinic acid, a sodium salt, it will positively increase the leucocytes. That can easily be demonstrated by a certain dosage. A thirty-five-pound dog can be given as high as half a gram a day, and unless we keep it up and maintain a threefold increase of the leucocytes, at the end of ten days you have the leucocytes in the peripheral circulation. But if you go over that dose, you have a leucopenia.

As to whether the leucocytes are of any value or not, laboratory experience in my mind does not show that they are any more active than the other, but I believe they are an advantage.

If I may answer the question of Dr. Ries I will say that if you believe Allen, of England, he has never lost a case of puerperal sepsis or septicæmia because he has always given them bacterins, and they recover on the thirteenth day.

Prophylactically the typhoid bacterin has been proven of value and that has been clearly established. It will at least modify the disease, if not prevent it. It does not prevent it in animals, but that is no criterion, because we can easily protect the laboratory animals from that particular strain.

I do not agree with the doctor that bacterins are not of any value. They are of value.

DR. RIES: I did not speak generally.

DR. BIEHN: The phylacogens are bacterial toxins and will be called such before long. I used phylacogen in the case of the wife of a member of this society. She had rheumatism. He called me up and said he had used everything without beneficial effect. I told him I had used phylacogen with apparent success in two cases, but with failure in two others. He injected only one-half of the dose which is advised, and called me up about three o'clock in the morning because his wife had developed an exceedingly violent toxic nephritis. He had an awful time with her, but she pulled through, although she still has albumin and casts, and it is some three months now. She was given a second dose and it did not affect the rheumatism in any way, yet I have had apparently successful results in two cases of rheumatism.

# BOOK REVIEWS

DER INFANTILISMUS, DIE ASTHENIE UND DEREN BEZIEHUNGEN ZUM NERVENSYSTEM. By Prof. Paul Mathes, M. D. Berlin: S. Karger.

In this book the author endeavors to establish the fact that infantilism and asthenia are not identical, as some authors have declared; and in the discussion of cases according to preponderance of symptoms and signs uses the names asthenic infantilism and infantile asthenia in describing them.

Anatomical conditions ("Hemmungsbilden") and the time of their appearance during the development of the individual are considered.

The author differentiates "disposition" toward disease (disease resulting from exogenous and endogenous influences) and "constitution" (organic law handed down from the parents).

In his observations from year to year of growing boys the author concludes that the lack of development in stature of different portions of the body depends upon the time at which the retardation of growth occurred, the part affected being the part which at that particular time was in active growth.

In the discussion of infantilism of the skeleton the author describes the spinal curvatures as due to the unequal development of the ventral and dorsal portions of the vertebræ, the phthisical chest as being due to lack of development of the first rib. Infantilism of the genitalia is also fully discussed, as well as the status lymphaticus and other diatheses. Asthenic enteroptosis and prolapse with the time of their most frequent occurrence are also fully dealt with. The second part of the book is a study of the clinical manifestations, embracing mental depression, especially before menstruation, and the physiological pathology of the sympathetic nervous system.

The book is clearly and forcefully written, showing the author's profound study of many cases and the logical conclusions drawn from them. It is a work which merits a careful translation into English.

H. A. POTTS.

ELECTRICITY IN GYNECOLOGY. By May Cushman Rice. The Practical Uses of Electricity in Diseases of Women. Second Edition. Chicago: L. I. Laing & Co.

This book is intended to supplement a course in electrotherapy. Anatomy and physics are omitted. The handling of electrodes with the technique of their preparation and use is described in detail for the purpose of assisting those already familiar with the principles involved in treating patients by electricity. These details are concisely set forth and with a moderation in results claimed unusual in a book of this nature. This is particularly evident in the chapters on uterine fibroids and on the use of the röntgen ray in carcinoma.

GOLDEN RULES OF SURGERY. By Augustus Charles Bernays, A. M., M. D., M. C. R. S. Second edition, revised and rewritten by William Thomas Coughlin, M. D. St. Louis: C. V. Mosby Company, 1913.

This little book consists exclusively of short, positive assertions, the text being classified so as to include chapters on such subjects as sepsis and asepsis, anæsthesia, shock, the operating room, general pathological conditions, and regional surgery. The two closing chapters are on "Scientific Contributions to the Literature of Medicine and Surgery" and "Science and Surgery."

One can truthfully say that there are incorporated in this brief work many excellent suggestions on surgical diagnosis and technique which, although at times owing to their positiveness might be questioned, yet for the student and general practitioner are quite in place, and will impress the reader with their importance. The chapter on "Anæsthesia," although short, is very good.

In the chapter on "Scientific Contributions to Literature" the author displays a certain amount of egotism, which not only detracts from the beauty of the sentiment with which he is endeavoring to impress the reader but rather embarrasses one's æsthetic sense.

The skilled surgeon as well as the general practitioner will find this little work not only a profitable but a pleasant evening's entertainment.

J. A. WOLFER.

HEALTH THROUGH A RATIONAL DIET. By Arnold Sorand, M. D., Carlsbad. Philadelphia: F. A. Davis.

In this book we have a most interesting and instructive lesson as regards the rational use of foods. Food is considered from every standpoint: first, as to its content of albumins, carbohydrates, and fats, and then as to the value of its salts with particular reference to phosphorus, iron, and potash. It is considered as to its energy-producing qualities and the tissue rebuilding.

Food values necessary in the different climates, in the different occupations, and in the different ages are all carefully considered. The relative merits of vegetarianism as opposed to a rational diet are carefully analyzed and the advantages of each clearly told. Food values in relation to sexual

power and reproduction are also considered to some extent.

The translation is beautifully made, and the book is read with an ease quite unusual in most books of this type. WM. R. CUBBINS.

EPIDEMIC CEREBROSPINAL MENINGITIS. By Abraham Sophian, M.D. St. Louis: C. V. Mosby Company, 1913.

Monographs of this type are welcomed chiefly by the ever-increasing class of medical men who desire to have at hand more detailed and fresher information of the advances in a definite field than can be obtained in the various systems of medicine. Cerebrospinal meningitis has in late years been the subject of much productive investigation which has yielded such valuable results both in diagnosis and in therapy that a collective report such as that embodied in this volume should meet with a warm welcome.

The author is exceptionally qualified for the presentation of this material, his association with the Research Laboratory of New York, where he carried out his own investigations on the bacteriology and serum reactions of the meningococcus, enabling him to speak with intimate knowledge of this aspect of the subject; while his experience in the Texas epidemic of 1912 yielded him a large series of observations of the epidemiological character and of the therapeusis of this disease.

The chapter on etiology, after a rather unnecessarily detailed historical preface, takes up the epidemiological aspects of cerebrospinal meningitis. The author, by an analysis of the history of the chief epidemics, is led to the conclusion that the most common predisposing agent is a period of sudden climatic changes leading to widespread occurrence in the community of a nasopharyngeal catarrh. Of 85 epidemics in the U. S. up to 1873, 37 raged in winter, 18 in winter and spring, and 23 in spring. The introduction of a virulent strain of meningococci, possibly carried over by a healthy person from a previous epidemic or carried from a recent epidemic in another country then may lead to the development of an epidemic.

The virulent strain of meningococcus may be merely implanted on a pre-existing nasopharyngitis or be the chief cause of the nasopharyngitis. The portal of entry is at all events most probably always the nasopharynx. In only certain cases, however, does further extension occur. Dopter states that it is really an epidemic of rhino-pharyngitis with which one deals — an epidemic complicated at times by meningitis which develops in a number of persons who are susceptible of cerebral invasion.

That the proportion of these susceptible cases is comparatively small is shown interestingly by the number of carriers found by bacteriological examination of the nose and throat of those who have come in contact with meningitis cases. Statistics of carrier studies in various epidemics have shown as high as 70 per cent of contacts to be meningococcus carriers.

The presence of these carriers is considered by the author to be the chief factor in the dissemination of the disease. The closing of schools and the forbidding of large gatherings are logical preventive measures. In Houston, in 1912, the visit of a well-known evangelist was followed at once by a large increase in the incidence of meningitis cases. The author points out the importance of systematic examination of the nasopharynx of all members of a family in which a case has occurred and the maintenance of quarantine until negative cultures are obtained. The methods of procedure are given at some length.

In this connection also valuable help is afforded by the discussion under the bacteriology of the meningococcus, of the other members of the gram-negative group of cocci since all of these may be encountered in throat cultures. Their differentiation by cultural characteristics is usually satisfactory. Of the various specific serum reactions Sophian considers the complement-fixation test with McNeil's specific meningococcic antigen to be at present the most reliable.

Under the symptomatology of the disease the author divides the acute form into an accumulative and an active stage. In many cases during an epidemic there is not the classical acute onset but an appreciable period of more or less definite prodromal symptoms. These, Sophian considers, correspond to the invasion of the general circulation by the meningococci from the nasopharynx with simultaneous beginning irritation of the meninges and accumulation of cerebrospinal fluid. A history of exposure, fever, headache, repeated explosive vomiting, herpespetechia, photophobia, dilated, sluggishly responding pupils, tenderness at angle of jaws, bulging fontanel, irregular pulse or respiration; a significant grouping of these may occur before the outbreak of more evident symptoms of meningitis. In no disease is early diagnosis of more value to the patient.

Flexner, in a recent article on the causation of certain accidents in the subdural injection of antimeningitis serum, speaks of Sophian as having had the largest personal experience in this country with the administration of the serum. We are prepared therefore to find as we do an unusually full and instructive discussion of this feature of the therapy. The use of simultaneous blood pressure determination in controlling the amount of serum injected is strongly and convincingly advocated as well as the use of the gravity method of injection in all except such cases as have a very thick plastic exudate. Prophylactic and therapeutic use of antimeningococcus vaccine is a new field for which the author claims attention.

The most serious defect in the book is the lack of a bibliography. The insertion of detailed quotations from the work of many men presupposes a type of

reader to whom some means of ready access to the original articles is due.

The lack of any attempt to describe the pathology of the disease is also unfortunate since it means that the book must always be supplemented and cannot serve as a complete reference to its subject.

M. C. PINCOFFS.

VICIOUS CIRCLES IN DISEASE. By Jamieson B. Hurry, M. A., M. D. (Cantab.) Second edition. London: J. & O. Churchill, 1913.

The author explains in his introduction that by the term "vicious circle" is meant a morbid process in which two or more disorders are so correlated that they reciprocally aggravate and perpetuate each other. He regards these circles as playing an important rôle in pathology, though his material, as here formulated, is entirely clinical. His effort is to discuss intelligently the pernicious influence on the progress of disease which these circles possess, as well as the large part the *ars medendi* plays in "breaking the circle." Vicious circles are first classified into what may be termed their natural orders, several examples from each order being presented.

The various systems of the body are then taken *seriatim*, so that attention may be drawn to diseases which are liable to this complication. The principal etiological factors are discussed in a special chapter. Emphasis is next laid on the necessity of breaking the circle before recovery can take place, instances being given to show how this is accomplished, both by nature and by art.

The author's aim is to give a clearer insight into problems of pathology and of rational therapeutics. Most of his material has previously appeared in the columns of the *British Medical Journal*, *The Lancet*, *The Practitioner*, and *The Medical Press*. In general, the volume presents a definite practical value, and reveals a marked philosophical tendency and a mid-Victorian condition on the part of the author.

THE MODERN HOSPITAL — ITS INSPIRATION; ITS ARCHITECTURE; ITS EQUIPMENT; ITS OPERATION. By John A. Hornsby, M.D., and Richard E. Schmidt. Philadelphia: W. B. Saunders & Co., 1913.

This very comprehensive volume is somewhat of a pioneer, as there is a dearth of literature upon the subject of modern hospital financing, building and management. The collaboration of physician and architect in the preparation of this book has given us a valuable guide to the whole hospital question whether it is designed to construct and operate a municipal or private hospital. In the introduction the authors discuss the general hospital, its division into three classes, viz., charitable, part for pay patients and part for charitable ones, and one accepting pay patients only.

Considerable space is given to financing. Plans, arrangement, details of structure, permanent installation, etc., are fully considered.

The equipment of the complete hospital as regards diet kitchens, supplies, operating rooms instruments, laundry, etc., is fully considered, and everything regarding the building and management of the hospital is advocated which makes for efficiency, economy, and care of patients. H. A. POTTS.

REPRODUCTION IN THE HUMAN FEMALE. By James Young, M. D., F. R. C. S. (Ed.) Edinburgh and London: William Green & Sons.

The investigations upon which this work is based were carried out in the Royal Infirmary and in the laboratory of the Royal College of Physicians, Edinburgh. They comprise an account of the structure of the uterine mucous membrane and the functional changes which it undergoes during menstruation and pregnancy.

The structure of the uterine mucous membrane is first described in accordance with the most recent knowledge, particular emphasis being given to the conformation of the interstitial connective tissue. The author takes an advanced position relative to the structure of the tissue network of the stroma. Many early observers regarded this method as a structural entity completely independent of the stroma, but Dr. Young attempts to show that the cell cytoplasm has been drawn on to furnish the material of which the network is formed. Again in discussing the nature of the blood supply to the corpus mucosa, he goes further than to say that blood is carried through special endothelial capillaries, affirming that the so-called blood-vessels of the endometrium are in reality simply undifferentiated tracks through the stroma. "In none of the specimens is there any evidence of muscle, fibrous, or elastic tissue in any part of the uterine stroma except that adjacent to the muscular coat. Where the vessels require extra support they derive it through a condensation of the neighboring tissue cells." "The blood-vessels, in other words, have no specialized wall, but consist merely of tracts or channels through the soft stroma protoplasm, by means of which a rich supply of blood is carried to every part of the mucous membrane." He further agrees with Leopold and Webster that the intercellular spaces in the stroma are filled with lymph.

Following rather closely in the footsteps of Hitschmann and Adler, the chapter devoted to menstruation describes the four steps of premenstrual swelling, bleeding, repair and quiescence. The subject is carried beyond a mere statement of observations, however, into an elaborate argument as to the significance of the changes now well recognized. As a result of this certain definite and advanced theories are maintained. Thus, in defining the true nature of the mucosa in terms of the functional changes which it exhibits, Young designates it not merely as a spread-out lymph surface, such as Leopold named it, but as a "potential blood sponge." Again, with reference to the causation of blood escape in the normal menstruating uterus, an interesting hint is thrown out as to the etiological

factor in certain forms of menorrhagia. Dr. Young believes that the cause of œdema and hæmorrhage in the normal mucosa is due to factors identical in nature with, and differing only in the degree of activity from, those operating in certain abnormal conditions, in which case additional support is contributed to the idea that many cases of menorrhagia and metrorrhagia are directly secondary to an abnormal activity of the ovarian influence.

Chapters three and four explain the embedding of the ovum comprising phenomena now well understood. The intra- and extrachorionic activities of the fœtal epithelium and the mode of opening up of maternal vessels and of the formation of blood sinuses is described in detail. Some consideration is given also to the question of placental fragments and to chorio-epithelioma. The author maintains that an escape of blood by merely mechanical means from a broken-down vessel wall does not suffice to explain the manner in which the fœtal elements derive their nourishment. Hence he speaks of a "chorionic influence" which "in some way or other determines the occurrence of protoplasmic changes in the cells, which lead to their imbibing fluid which can often be seen to have accumulated in the cell body under a hydrostatic tension clearly higher than the pressure of the intravascular blood and of the fluid in the surrounding tissue spaces.

The Tescher-Bryce ovum and those of Peters, of Jung, and of Leopold are briefly described, followed by a detailed report of the author's own specimen. For this he estimates an age of 13½ to 14½ days, thus placing it between the Tescher-Bryce and the Peters ova in measurements.

The nature of the chorionic influence and the mode of its spread is discussed briefly without, however, the development of any very definite theory as to its chemistry. The changes taking place in the endometrium in the formation of the decidua are entered upon in detail, as is a discussion as to the functions of this membrane. Concerning this function the author says:

"The function of the decidual membrane is to prevent an irregular and increasing opening-up and expansion of the maternal vessels and a tearing-up of the mucosa by fluid and blood after the tissue changes necessary for an adequate supply of the maternal blood for the engrafted ovum have been accomplished. It is by virtue of this action that the chorionic invasion of the tissue is limited and that the increase in the implantation chamber is prevented by an erosion or displacement of tissue."

In some respects the most important feature of this volume is the collection of plates and microphotographic reproductions. These are excellent in character, abundant in number and unusually well reproduced. They not only serve to render the text more understandable—of definite value in a work of such specialization as this—but, to those familiar with the more recent studies in placentation, such reproductions are of greater value than any teacher's theories.

In stating that for the first time it is shown that the structural conformation of the uterine mucosa is intimately bound up with menstruation and with the processes associated with fœtal nutrition the author apparently claims overmuch, considering alone Webster's very fundamental work on placentation in 1901 and the exposition of Hitschmann and Adler's research in 1907. Yet, coming at this time, the present volume shows genuine research and is of a definite value as an addition to the literature of the subject. While the author goes beyond mere demonstration of findings and attempts to establish advanced theories, it must be said that his theories reveal scientific imagination. In most respects they are logical in their deduction and attractive in their presentation.

CAREY CULBERTSON.

MUSCLE SPASM AND DEGENERATION IN INTRATHORACIC INFLAMMATIONS AND LIGHT TOUCH PALPATION. By Francis Marion Pottenger, A. M., M. D., LL. D., Medical Director of the Pottenger Sanatorium for Diseases of the Lungs and Throat, Monrovia, Cal. St. Louis: C. V. Mosby Co., 1912.

This volume is designed to promulgate, according to the author's methods and observations, our knowledge regarding the diagnosis of diseases of the thoracic organs. He lays great stress upon inspection and palpation, especially light touch palpation, which methods have heretofore not been recognized as being of especial value as diagnostic aids in intrathoracic diseases. According to the observations and studies by the author those diseases when acute produce a spasm of overlying muscles which degenerate when the process becomes chronic. Even in a degenerated muscle, spasm is produced by an acute exacerbation of a chronic process, as frequently is the case in pulmonary tuberculosis. Many of the facts presented are not new and the only claim the author has to originality is that he has worked them out as an independent observer and has applied them to clinical cases to his own satisfaction as to their diagnostic aids.

The author discusses the cause of this degeneration, further outlining what can be determined by noting the condition of the neck and chest muscles in acute and chronic inflammations of the lungs and pleura as well as the relation this muscle change bears to the bony anomalies of the upper thorax.

The light touch palpation and the application of it in the delineation of the deep-seated organs is distinctly the author's, and if it can be developed by the average diagnostician to the degree which the author has attained it will mark a distinct advance in clinical diagnosis.

H. A. POTTS.

SURGERY, GYNECOLOGY AND OBSTETRICS

AN INTERNATIONAL MAGAZINE, PUBLISHED MONTHLY

VOLUME XVIII MARCH, 1914 NUMBER 3

# THIRTEEN YEARS' EXPERIENCE WITH PYLOROPLASTY[1]

## A STUDY OF ONE HUNDRED CASES

BY J. M. T. FINNEY, M. D., BALTIMORE
Professor of Clinical Surgery, Johns Hopkins University
and
JULIUS FRIEDENWALD, M. D., BALTIMORE
Professor of Gastro-Enterology, College of Physicians and Surgeons

IT is now over twelve years since the operation of pyloroplasty was first introduced by Finney, who, at the annual meeting of the American Surgical Association, in 1902, described the operation and reported five successful cases. It seemed to us, therefore, that it would not be out of place, after this period of time, to bring together the results of this operation, and discuss the advantages or disadvantages of this procedure over others performed for a similar purpose, and to draw, as far as possible, definite conclusions regarding its indications and value as a surgical procedure. In gathering our experiences, we deem it most important that not only should the immediate effects be noted, but also the final results, i.e., the results obtained after a term of years.

The special operation of pyloroplasty consists in a horseshoe-shaped incision through the pylorus, extending down through the anterior walls of the duodenum, and the stomach, after they have been approximated, and sutured much as in a lateral anastomosis. Since this time Narath, Jaboulay, Henle, Kocher, and others have described similar methods or modifications of this operation, but none of these present any material advantage over the original method. The operation may be described as follows: Adhesions binding the pylorus to neighboring organs should be thoroughly freed, as well as the pyloric end of the stomach, and first portion of the duodenum.

The thoroughness with which the pyloric end of the stomach and the upper end of the duodenum are freed determines largely the ease and success of the operation. Much advantage is gained from this so-called mobilization of the duodenum. Kocher later emphasized the great importance of this procedure. A suture to be used as a retractor is taken in the upper wall of the pylorus, which is then retracted upward by means of this suture. A second suture is then placed in the anterior wall of the stomach, and a third in the anterior wall of the duodenum at equidistant points from the suture just described in the pylorus. The second and third sutures are taken as near the opposing free borders of the stomach and duodenum as possible, and mark the lower ends of the gastric and duodenal incisions respectively.

Traction is then made upward on the pyloric suture, and downward in the same plane on the gastric and duodenal sutures.

[1] Read before the Clinical Congress of Surgeons of North America, Chicago, November 12, 1913.

This keeps the stomach and duodenal walls elevated and taut, and allows the placing of the subsequent sutures with greater facility than if they remained retracted and relaxed. The peritoneal surfaces of the duodenum and stomach along its greater curvature, are then sutured as far posteriorly as possible. For this row the continuous silk suture is to be preferred.

After the posterior line of sutures has been placed and tied, an anterior row of mattress sutures is taken, which are not tied. These sutures after they have been placed are drawn aside, thus exposing the line of incision.

After all the anterior stitches have been placed and retracted the incision is made in the shape of a horseshoe. The anterior and posterior lines of sutures should be placed far enough apart to give ample room for the incision to be made between them. Beginning in the gastric wall, the incision is carried upward to and through the pylorus, and around into the duodenum. Hæmorrhage is then stopped. Scar tissue or active ulcers present in the gastric or duodenal anterior wall may be excised through this incision.

Those in the posterior wall we have been treating of late just as other chronic ulcers; i.e., excising the overhanging edges of mucous membrane, and incising the dense fibrous base; care being exercised to avoid perforation of the posterior wall of the stomach and to stop all hæmorrhage by ligature or suture.

The opportunity thus afforded to explore digitally and inspect the ulcerated area and then excise it through this incision is in our judgment one of the strongest points in favor of the operation.

A continuous catgut suture is now taken through all the coats of the stomach and duodenum on the posterior side of the incision in order to reinforce this line of sutures. The anterior sutures are then straightened out and tied, and the operation thus completed. The mattress sutures may be reinforced with as many Lembert sutures as may be thought best. All the stitches are thus placed and the posterior row tied before the bowel is opened, and it remains open only long enough to control the hæmorrhage and excise any ulcer that may be present, thus giving the minimum of exposure of infected surfaces.

The size of the newly formed pylorus may be made as large or small as desired. Unless the stomach is very much dilated or has descended to an unusual extent, the lower limit of the new pylorus will be found to be at or near the level of its most dependent part.

We have studied the records of 100 cases in which the operation of pyloroplasty has been performed, covering a period dating from 1900 to the present time. Of these the immediate results were noted in all cases; the remote results in 78 cases.

In analyzing our results we note that the largest proportion of cases in which pyloroplasty was performed occurred between the 35th and 50th years.

TABLE PRESENTING CASES ARRANGED ACCORDING TO AGE

| Years | No. | Per Cent | Years | No. | Per Cent |
|---|---|---|---|---|---|
| 20–25 | 5 | 5 | 45–50 | 15 | 15 |
| 25–30 | 9 | 9 | 50–55 | 10 | 10 |
| 30–35 | 9 | 9 | 55–60 | 11 | 11 |
| 35–40 | 20 | 20 | 60–65 | 3 | 3 |
| 40–45 | 14 | 14 | 65–70 | 4 | 4 |

Of the total number there are 63 males and 37 females. The following tables illustrate the number of cases observed in males and females according to age.

CASES GROUPED ACCORDING TO AGE AND SEX

| Years | Males No. | Males Per Cent | Females No. | Females Per Cent | Total No. | Total Per Cent |
|---|---|---|---|---|---|---|
| 20–25 | 1 | 1 | 4 | 4 | 5 | 5 |
| 25–30 | 4 | 4 | 5 | 5 | 9 | 9 |
| 30–35 | 7 | 7 | 2 | 2 | 9 | 9 |
| 35–40 | 9 | 9 | 11 | 11 | 20 | 20 |
| 40–45 | 10 | 10 | 4 | 4 | 14 | 14 |
| 45–50 | 10 | 10 | 5 | 5 | 15 | 15 |
| 50–55 | 10 | 10 | 0 | 0 | 10 | 10 |
| 55–60 | 9 | 9 | 2 | 2 | 11 | 11 |
| 60–65 | 2 | 2 | 1 | 1 | 3 | 3 |
| 65–70 | 1 | 1 | 3 | 3 | 4 | 4 |
| Total | 63 | 63 | 37 | 37 | 100 | 100 |

The duration of the symptoms in our cases varied greatly, ranging from one and one-half months to twenty-five years; the average duration being nine and a half years. The following table presents the cases grouped according to the duration of symptoms.

CASES GROUPED ACCORDING TO DURATION OF SYMPTOMS

| Time | No. of Cases | Time | No. of Cases |
|---|---|---|---|
| 1½ months | 1 | 4 years | 10 |
| 2 months | 1 | 5 years | 8 |
| 3 months | 2 | 8 years | 3 |
| 6 months | 5 | 9 years | 1 |
| 8 months | 4 | 10 years | 6 |
| 9 months | 2 | 11 years | 1 |
| 10 months | 1 | 12 years | 3 |
| 1 year | 15 | 15 years | 2 |
| 1½ years | 5 | 17 years | 1 |
| 2 years | 9 | 20 years | 5 |
| 3 years | 11 | 25 years | 1 |
| 3½ years | 1 | | |

Average duration of symptoms, 9½ years; 8½ years in males, and 11 years in females.

We have noted the principal symptoms observed in both males and females at various ages. Of these, pain was observed in 92 per cent of cases (58 males and 34 females); vomiting occurred in 64 per cent of cases (44 males and 20 females); hæmatemesis in 21 per cent of cases (15 males and 6 females); melæna in 46 per cent (29 males and 17 females); retention in 42 per cent (27 males and 15 females).

TABLE PRESENTING THE PRINCIPAL SYMPTOMS ARRANGED ACCORDING TO THEIR OCCURRENCE AT VARIOUS AGES

| Age | Pain | | | Vomiting | | | Hæmatemesis | | | Melæna | | | Retention | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | M. | F. | Total | M. | F. | Total | M. | F. | Total | M. | F. | Total | M. | F. | Total |
| 20–30 | 4 | 9 | 13 | 3 | 5 | 8 | 1 | 1 | 2 | 2 | 5 | 7 | 2 | 4 | 6 |
| 30–40 | 15 | 12 | 27 | 10 | 7 | 17 | 4 | 2 | 1 | 7 | 7 | 14 | 6 | 5 | 11 |
| 40–50 | 19 | 9 | 28 | 14 | 5 | 19 | 6 | 2 | 8 | 12 | 2 | 14 | 9 | 4 | 13 |
| 50–60 | 18 | 2 | 20 | 16 | 1 | 17 | 3 | 0 | 3 | 6 | 2 | 8 | 8 | 1 | 9 |
| 60–70 | 2 | 2 | 4 | 1 | 2 | 3 | 1 | 1 | 2 | 2 | 1 | 3 | 2 | 1 | 3 |
| Total | 58 | 34 | 92 | 44 | 20 | 64 | 15 | 6 | 21 | 29 | 17 | 46 | 27 | 15 | 42 |

In the following table we have arranged the cases of gastric and duodenal ulcers according to age and sex. There are 55 cases of gastric ulcer (36 males and 19 females) and 32 duodenal ulcers (21 males and 11 females) making a total of 87 cases. In addition pyloroplasty was performed upon two cases for gastroptosis, in three for pylorospasm and six for pyloric stenosis, due to adhesions (one due to cholelithiasis, four due to adhesions of undetermined cause, and one to closing of a former gastro-enterostomy opening). Two cases presented both gastric and duodenal ulcers.

TABLE GROUPING THE GASTRIC AND DUODENAL ULCERS ACCORDING TO AGE AND SEX

| Age | Males | | Females | |
|---|---|---|---|---|
| | Gastric No. | Duodenal No. | Gastric No. | Duodenal No. |
| 20–30 | 4 | 1 | 4 | 2 |
| 30–40 | 11 | 5 | 8 | 4 |
| 40–50 | 10 | 6 | 4 | 3 |
| 50–60 | 10 | 8 | 2 | 0 |
| 60–70 | 1 | 1 | 1 | 2 |
| Total | 36 | 21 | 19 | 11 |

Of the 87 cases, obstruction of the pylorus occurred in 64 instances.

The obstruction was due in 51 cases to gastric ulcer,[1] in 7 to duodenal ulcer, and in 6 to adhesions, probably resulting from healed ulcers. There were four cases requiring secondary operations (gastro-enterostomy).

TABLE ILLUSTRATING CASES REQUIRING SECONDARY OPERATION—GASTRO-ENTEROSTOMY

| Age | Sex | Cause |
|---|---|---|
| 58 | F | Pyloric obstruction due to adhesions produced by gall-bladder infection, eleven years after the pyloroplasty. |
| 52 | M | Duodenal ulcer formed five years after pyloroplasty. |
| 48 | M | Infected sutures causing immediate obstruction at site of pyloroplasty requiring gastro-enterostomy after five days. |
| 41 | M | Duodenal ulcer after one and one-half years. |

In one case there occurred a pyloric obstruction due to adhesions produced by cholecystitis eleven years after the pyloroplasty. In the second, a duodenal ulcer formed four years after the pyloroplasty. In the third, infected suture (linen thread) caused early obstruction at the site of the pyloroplasty, and in the fourth a duodenal ulcer formed after a year and a half. In all of these cases secondary gastro-enterostomies had to be performed, which gave entire relief.

In both of the cases where a duodenal ulcer recurred, an attempt had been made, at the original operation, to excise a duodenal ulcer, but owing to the fact that it was so situated that it could not be entirely excised, it is more than probable that in one of the cases, at least, it was a direct recurrence. In the

[1] While the histories state positively in 51 cases that the obstruction was due to gastric ulcer, and in only 7 to duodenal ulcer, it is possible that in the earlier cases, when we did not examine as carefully as now, the error may have been made in certain cases of calling a duodenal a gastric ulcer, but we cannot believe that the error was very large.

other, the second ulcer appeared to be so far removed from the site of the first, as to give the impression, at least, that it was an independent ulcer.

The following table illustrates the immediate results of pyloroplasty of the 100 cases, consisting of 63 males and 37 females; the operations proved satisfactory immediately in 57 males and 33 females (90 per cent) and unsatisfactory in 6 males and 4 females (10 per cent). The post-operative nausea and vomiting was almost entirely absent in most instances. In but five cases was there nausea or vomiting to any marked degree following operation. Vomiting occurred in two cases eight and twelve days after operation respectively, but this was due in each instance to gross errors in feeding. The great freedom from discomfort following immediately after operation is also to be noted as a distinct advantage of this procedure. In but seven instances were the patients greatly disturbed by nausea, flatulency, or distention, and the immediate results of this operation may be favorably compared with those observed after appendectomy when performed between attacks, being attended with almost as little discomfort. Diarrhœa after operation appeared in five instances, mainly, however, after the first week or ten days, and was usually due to errors in diet. Inasmuch as the operation is performed in most instances upon patients affected with pyloric obstructions, and often after having this condition for years, it is easily understood how, on account of the rapid passage of the gastric contents through the stomach, a weakened intestine may be overtaxed, and intestinal indigestion and diarrhœa be induced. On this account, as well as because the stomach has in most instances temporarily lost its tone, and inasmuch as in some instances portions of ulcers have not been entirely resected due to their location and extent, we have found it advisable to regulate the diet following immediately upon operation and continuing on for several months according to the following plan which has been found very satisfactory.

For two days after operation nourishment is administered only by means of rectal alimentation. Normal salt solution or plain water, after Murphy's method, is begun immediately after operation, with nutrient enemata at intervals of every four hours on the second and third days. On the third day after operation egg-albumin is given in teaspoonful doses, gradually increased to one-half ounce every two hours on the fourth day, and two ounces on the fifth day. On the eighth day any liquid is permissible, and on the eleventh day the patient is given a soft boiled egg; on the thirteenth, soft diet; on the fifteenth, very restricted light diet; on the sixteenth, a restricted light diet; on the eighteenth day, light solid food. Small quantities of water at a time are allowed by mouth after 24 hours.

DIET LIST FOLLOWING THE OPERATION OF PYLOROPLASTY

First day, first 12 hours, nothing by mouth; nutrient enemata every 4 hours, alternating with continuous salt solution by Murphy's method.

First day, second 12 hours, water in dram doses.

Second day, increase water gradually up to 1 ounce every two hours.

Third day, water, 1 ounce, alternating with albumin, 1 dram. Gradually increase quantities of each until

Eighth day, any liquid, 2 ounces every two hours.

Ninth day, any liquid, 3 ounces every two hours.

Tenth day, any liquid, 4 ounces every two hours (discontinue rectal feeding).

Eleventh day, one soft boiled egg in addition to any liquid.

Twelfth day, two soft boiled eggs in addition to any liquid.

Thirteenth day, soft diet.

Fourteenth day, soft diet.

Fifteenth day, very restricted light diet.

Sixteenth day, restricted light diet.

Seventeenth day, restricted light diet.

Eighteenth day, any digestible solid food.

After the eighteenth day the following diet list may be gradually followed, and should be continued for at least four or five months: Soups; any light soup. Meats; any

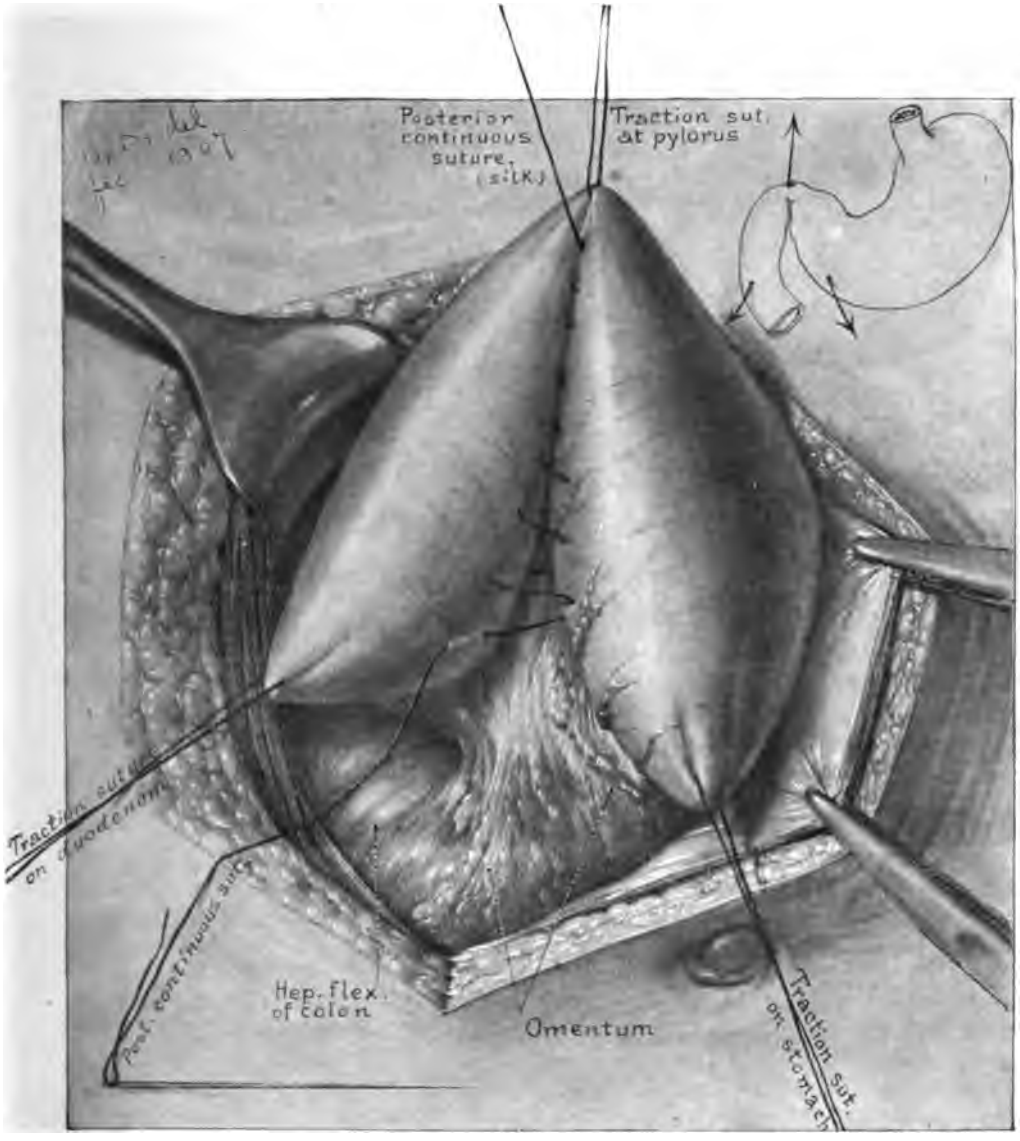



**Plate 1.** Showing traction stitches in pylorus, stomach, and duodenum. Posterior line of suture nearly completed. Finney in Kelly and Noble's Gynecology, Vol. II. Kindly presented by W. S. Saunders Co.

of the easily digestible meats, as brains, sweetbreads, beef, mutton, lamb, or poultry (best minced, and taken either broiled or boiled). Fish; mainly the white variety, mackerel, rock bass, as well as oysters (boiled or broiled). Eggs; in any form except fried. Vegetables; best taken mashed and strained; the easily digestible forms as asparagus, spinach, peas, beans, potatoes, carrots. Farinaceous food; any of the cereals; bread to be taken stale. Desserts; any of the light puddings. Fruits; mainly stewed. Fatty food; cream, butter and olive oil. Drinks; milk, buttermilk, cocoa, carbonated mineral waters and plain water.

The following must be avoided: Rich soups, fried foods, pork, veal stews, hashes, corned meat, potted meat, twice cooked

Plate 2. Posterior continuous suture placed and tied. Ends left long as retractors. Anterior row of mattress sutures placed but not tied. Finney in Kelly and Noble's Gynecology, Vol. II. Kindly presented by W. B. Saunders Co.

meat, liver, kidney, duck, goose, sausage, crabs, sardines, lobster, preserved fish, smoked fish, salted fish, salmon, cauliflower, celery, radishes, cabbage, cucumbers, sweet potatoes, tomatoes, beets, corn, salads, bananas, melons, berries, pineapple, hot bread, or cakes, nuts, candies, pies, pastry, preserves, cheese, strong tea, strong coffee, alcoholic stimulants.

IMMEDIATE RESULTS

| Age | Males | | Females | |
|---|---|---|---|---|
| | Satisfactory | Unsatisfactory | Satisfactory | Unsatisfactory |
| 20–30 | 5 | 0 | 7 | 2 |
| 30–40 | 15 | 1 | 13 | 0 |
| 40–50 | 19 | 1 | 8 | 1 |
| 50–60 | 16 | 3 | 1 | 1 |
| 60–70 | 2 | 1 | 4 | 0 |
| Total | 57 | 6 | 33 | 4 |

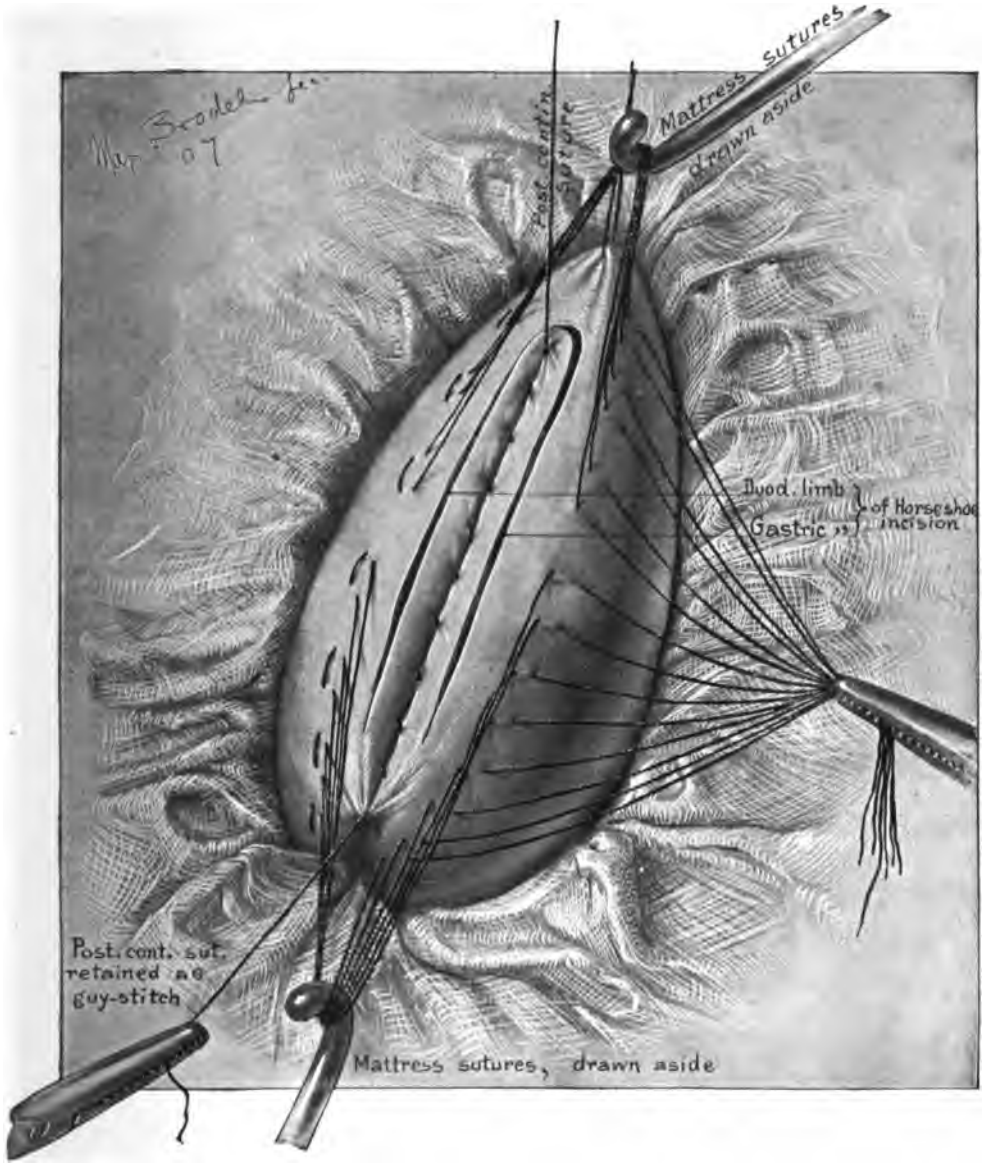



Plate 3. Anterior mattress sutures retracted. Incision completed through the anterior gastric and duodenal walls. Finney in Kelly and Noble's Gynecology, Vol. II. Kindly presented by W. B. Saunders Co.

In order to obtain a clear view as to the immediate results of the operation we have compared the gastric secretion, in the following four cases of pyloric stenosis due to ulcer, before the operation, with that obtained one and two months after operation. The figures given are an average of a number of examinations. The total acidity is first noted, then the amount of free hydrochloric acid, and finally the quantity of contents recovered, which in a measure represents the motor activity of the stomach. It is evident in every case that the total quantity of acid as well as the percentage of free hydrochloric acid, which may be exceedingly high before operation, is gradually reduced to normal, but that this does

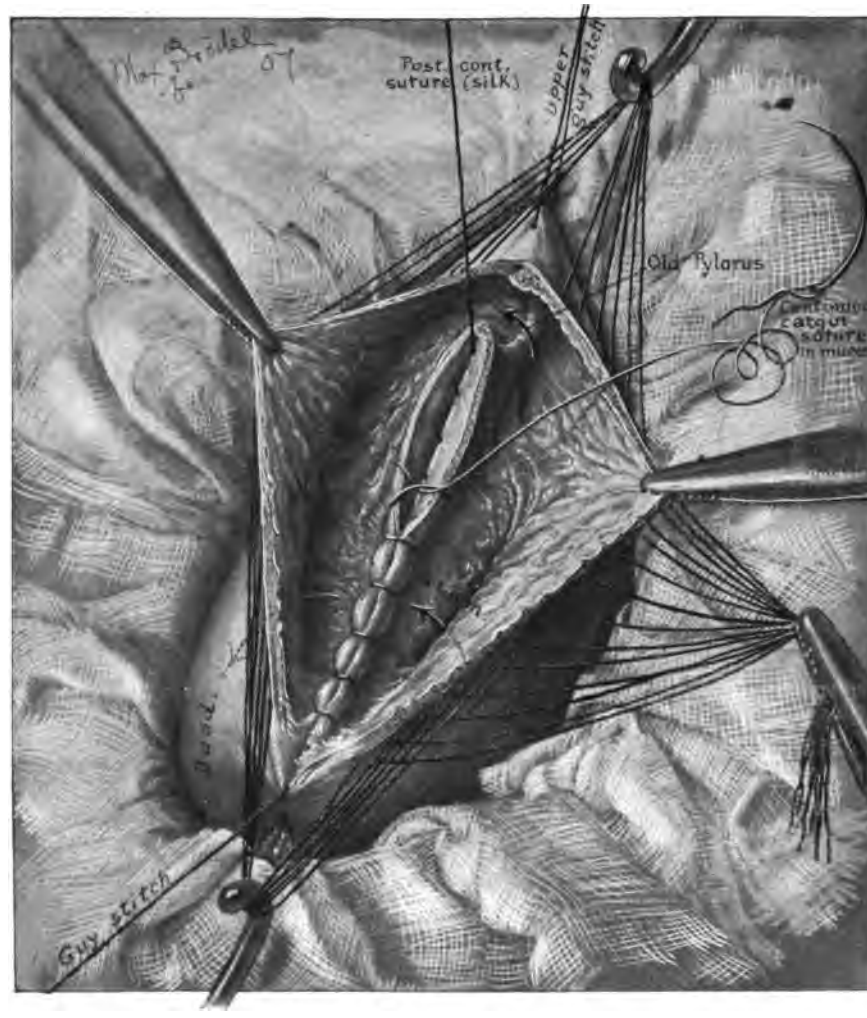



Plate 4. Anterior gastric and duodenal walls retracted, showing buttonhole suture of catgut partly placed in the free borders of the posterior walls. Finney in Kelly and Noble's Gynecology, Vol. II. Kindly presented by W. B. Saunders Co.

not occur immediately after operation, but requires about two months before the normal is established, after which it continues to remain stationary. Similarly the large quantity of contents obtained is gradually reduced to normal after operation, while the retention observed at first entirely vanishes. It is, therefore, evident, that while the secretory and motor functions of the stomach are at once markedly improved after pyloroplasty, these functions do not become normal immediately, but several months must elapse before perfectly normal conditions are established.

E. V. N., Operation May 13, 1904.

| | Total Acidity | Free HCl. | Quantity of Contents After Test Meal | On Fasting Stomach |
|---|---|---|---|---|
| Before operation: | | | | |
| April 2, 1904..... | 110 | 86 | 310 cc. | 245 cc. |
| After operation: | | | | |
| June 24, 1904.... | 74 | 62 | 82 cc. | 0 |
| July 20, 1904.... | 48 | 42 | 58 cc. | 0 |
| Sept. 5, 1904.... | 44 | 38 | 46 cc. | 0 |

R. M., Operation Dec. 16, 1905.

| | | | | |
|---|---|---|---|---|
| Before operation: | | | | |
| Nov. 10, 1905.... | 76 | 65 | 205 cc. | 185 cc. |
| After operation: | | | | |
| Jan. 21, 1905.... | 62 | 58 | 98 cc. | 0 |
| Feb. 24, 1905.... | 52 | 44 | 62 cc. | 0 |
| April 2, 1905.... | 48 | 36 | 50 cc. | 0 |

Plate 5. Mattress sutures previously placed now tied. Alternate Lemberts placed between the mattresss utures. Finney in Kelly and Noble's Gynecology, Vol. II. Kindly presented by W. B. Saunders Co.

| | | | | |
|---|---|---|---|---|
| C. E. R., Operation May 2, 1907. | | | | |
| Before operation: | | | | |
| April 15, 1907.... | 96 | 82 | 230 cc. | 200 cc. |
| After operation: | | | | |
| June 20, 1907.... | 92 | 76 | 88 cc. | 0 |
| July 25, 1907.... | 62 | 54 | 45 cc. | 0 |
| Sept. 2, 1907.... | 50 | 36 | 48 cc. | 0 |
| J. B., Operation March 19, 1902. | | | | |
| Before operation: | | | | |
| Mar. 12, 1902.... | 100 | 59 | 435 cc. | 400 cc. |
| After operation: | | | | |
| April 25, 1902.... | 84 | 52 | 85 cc. | 0 |
| May 28, 1902.... | 64 | 48 | 40 cc. | 0 |
| July 13, 1902.... | 54 | 42 | 45 cc. | 0 |

*Deaths following operation.* There were five deaths following immediately upon operation, these occurred from the fifth to the fifteenth day. In one instance death was due to persistent vomiting, due to an acute atrophy of the liver associated with the toxæmia of pregnancy, in a second and third to bronchopneumonia in very debilitated subjects, in a fourth to shock, associated with diabetes and followed by coma, and in a fifth to chronic nephritis and uræmia.

IMMEDIATE RESULTS—DEATHS

The following table illustrates the number of deaths following immediately upon operation, with cause of death:

| Sex | Age | Day of Death After Operation | Cause of Death |
|---|---|---|---|
| F | 26 | 15 | Persistent vomiting associated with pregnancy. |
| M | 60 | 5 | Atrophy of liver. |
| M | 50 | 6 | Bronchopneumonia. |
| M | 58 | 5 | Shock. |
| M | 59 | 5 | Chronic nephritis (uræmia). |

The results of pyloroplasty during the first year of the operation are satisfactory on

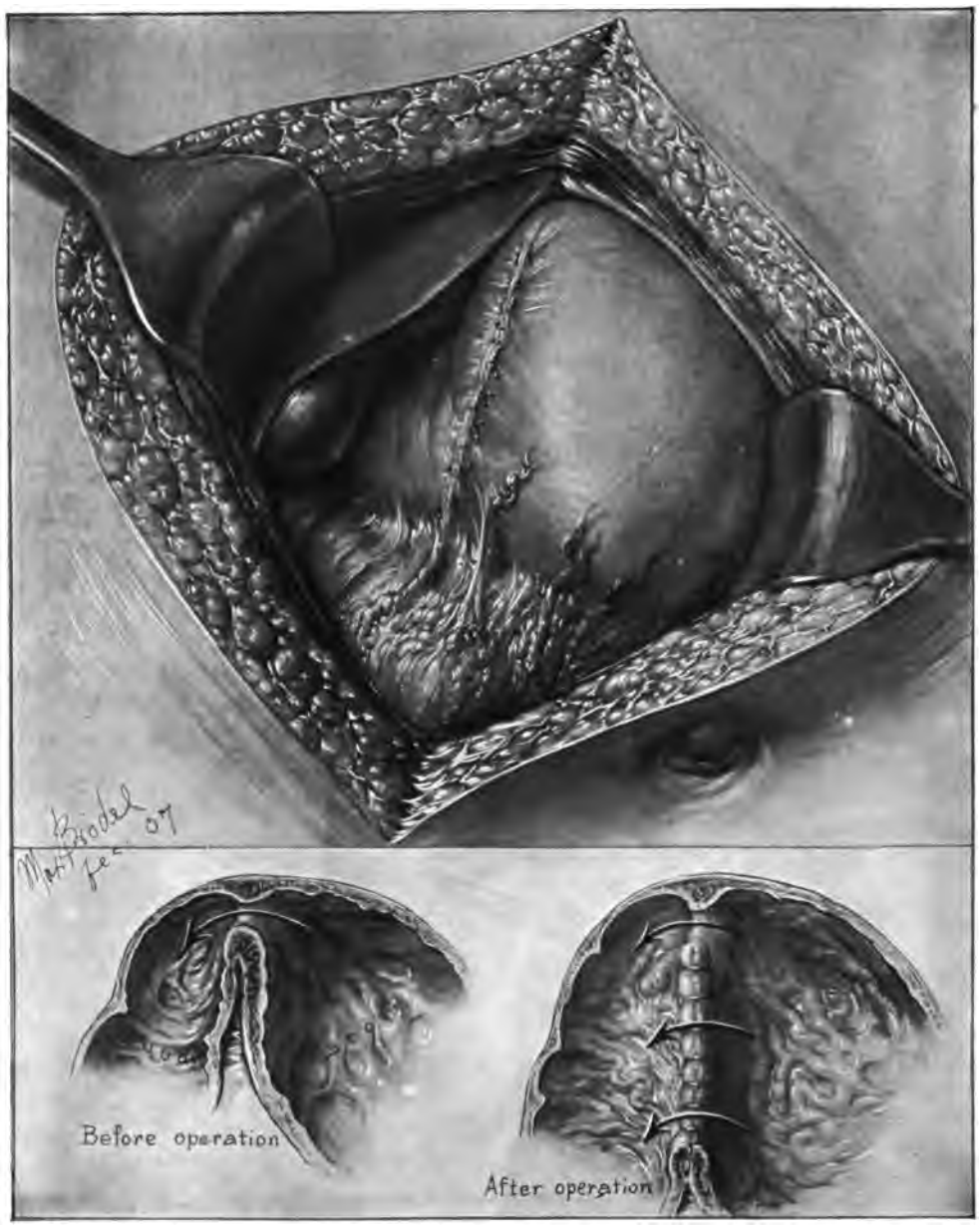



Plate 6. Operation completed. Showing relative sizes of old and new pylorus. Finney in Kelly and Noble's Gynecology, Vol. II. Kindly presented by W. B. Saunders Co.

the whole. Of the 100 cases operated on, 5 had died immediately following operation and the results of 13 could not be obtained; the results are therefore tabulated only in 82 cases, consisting of 54 males and 28 females; the results were entirely satisfactory in 51 males and 26 females, that is in 77 instances (93.9 per cent), and unsatisfactory in 3 males and 2 females, that is in 5 instances (6.1 per cent).

TABLE ILLUSTRATING RESULTS OF OPERATION DURING FIRST YEAR

| Age | Males | | Females | |
|---|---|---|---|---|
| | Satisfactory | Unsatisfactory | Satisfactory | Unsatisfactory |
| 20–30 | 4 | 0 | 4 | 1 |
| 30–40 | 14 | 1 | 11 | 1 |
| 40–50 | 18 | 1 | 7 | 0 |
| 50–60 | 14 | 1 | 0 | 0 |
| 60–70 | 1 | 0 | 4 | 0 |
| Total | 51 | 3 | 26 | 2 |

RESULTS AFTER FIRST YEAR OF REMAINING 78 CASES

Of the total of 100 cases the final results of 17 are unknown, while 5 died soon after operation, leaving 78 cases. Of these, the results were satisfactory in 50 males and 23 females, that is 73 (93.6 per cent), and unsatisfactory in one male and 4 females, that is 5 (6.4 per cent).

RESULTS AFTER FIRST YEAR OF REMAINING 78 CASES

| Age | Males | | Females | |
|---|---|---|---|---|
| | Satisfactory | Unsatisfactory | Satisfactory | Unsatisfactory |
| 20–30 | 4 | 0 | 3 | 1 |
| 30–40 | 14 | 0 | 10 | 2 |
| 40–50 | 18 | 0 | 6 | 1 |
| 50–60 | 13 | 1 | 0 | 0 |
| 60–70 | 1 | 0 | 4 | 0 |
| Total | 50 | 1 | 23 | 4 |

In the following table are noted the number of cases that have been observed from one to twelve years after operation, together with the final results. The average of the satisfactory recoveries is shown to be 93.4 per cent. If we deduct from this number 5 per cent, that is those cases already referred to in which death occurred immediately upon operation, the percentage of favorable results is reduced to 88.8 per cent.

As an additional factor in determining the satisfactory results in addition to freedom from digestive disturbances, gain in weight, and general well-being, we have had a series of X-ray plates made in five cases, all of which had been operated on over one year, and the stomach was found to be functionating perfectly normally in all, emptying itself at a normal rate. As a whole the final results of pyloroplasty have, therefore, proven satisfactory.

END RESULTS IN YEARS AFTER OPERATION OF PYLOROPLASTY

| Years | Total Number of Cases | Satisfactory Results | Unsatisfactory Results | Percentage of Satisfactory Recoveries |
|---|---|---|---|---|
| 1 | 4 | 4 | 0 | 100 |
| 2 | 5 | 5 | 0 | 100 |
| 3 | 12 | 11 | 1 | 91.6 |
| 4 | 7 | 7 | 0 | 100 |
| 5 | 5 | 5 | 0 | 100 |
| 6 | 8 | 8 | 0 | 100 |
| 7 | 6 | 6 | 0 | 100 |
| 8 | 10 | 8 | 2 | 80 |
| 9 | 8 | 8 | 0 | 100 |
| 10 | 5 | 4 | 1 | 80 |
| 11 | 4 | 4 | 0 | 100 |
| 12 | 4 | 3 | 1 | 75 |

Average of percentage of satisfactory recoveries. 93.8
Deaths 5

Favorable results 88.8

From our observations of a study of 100 cases of pyloroplasty, we believe we are justified in drawing the following conclusions.

1. The operation has its greatest indication in the relief of pyloric stenosis due to chronic ulcers, situated at or near the pylorus, and on either side of it, or resulting from cicatricial contraction following the healing of such ulcers. It is often a useful procedure in cases of hæmorrhage due to gastric ulcers on the lesser curvature, or to duodenal ulcers which cannot be controlled medically, and which threaten the life of the patient, as well as in the chronic dyspepsias due to ulcers which have not been relieved by medical treatment.

2. The operation has certain advantages over gastro-enterostomy and but few of its disadvantages.

3. Such objections as are urged against the operation, e.g., its inapplicability in the presence of adhesions surrounding the pylorus, as well as in the presence of active and bleed-

ing ulcers, and also because of the fact that the new opening is not at its lowest point, taking advantage of gravity, are according to our experience more fanciful than real, since the operation has frequently been performed under these conditions with most gratifying results. The interesting experimental work of Cannon and Blake and others supports this contention.

4. The only contra-indications to the operation are inability to mobilize the duodenum when adhesions are too dense, and thickening and infiltration about the pylorus due to hypertrophic forms of ulceration. These conditions, however, in our experience occur but rarely.

5. In atony or gastroptosis with slight motor insufficiency such as is observed in the water-trap stomach; or in nervous dyspepsia, i.e., in gastric disturbances not dependent upon organic disease, this operation is contra-indicated.

6. The special advantages of this operative procedure lie in its affording the opportunity to excise all ulcers in the anterior walls of the stomach or duodenum after direct inspection of the part affected; also the application of treatment to ulcers situated in the posterior walls. It does not greatly disturb the normal relation between the stomach and intestines as is the case in other operations.

7. From our experience with the operation, the immediate as well as the final results are most encouraging. While in some instances partial gastrectomy or gastro-enterostomy is undoubtedly the operation of choice, nevertheless, on account of its simplicity and because of its satisfactory end results, we believe that pyloroplasty will continue to retain its position as a safe and useful procedure.

---

# CLINICAL SUGGESTIONS BASED UPON A STUDY OF PRIMARY, SECONDARY (CARCINOMA?) AND TERTIARY OR MIGRATORY (CARCINOMA) EPITHELIAL HYPERPLASIA IN THE BREAST[1]

By WM. CARPENTER MacCARTY, M. D., Rochester, Minnesota
Mayo Clinic

THE writer's reasons for making the following contribution to the pathology and therapeutics of the breast may be briefly stated.

An examination of the literature reveals that there are at least 147 different terms which are utilized to express pathological mammary conditions. These are confusing to the great majority of practitioners, surgeons, teachers, and students. Many of these terms are synonyms, an example of which may be seen in the fact that there are twelve synonyms for the condition which Billroth and Koenig described as "mastitis cystica chronica."

The classifications which have been and are utilized are numerous and very different. This may be seen also in the fact that the best authorities disagree upon the character of such conditions as "cystadenoma," "abnormal involution," and "senile parenchymatous hypertrophy." These may be found described by some writers as benign conditions and by others as malignant conditions.

The clinical uncertainty which exists as a result of the confusion of terminology, the multiplicity of classifications, the divergence of operative advice from the general pathologist, and the lack of recognition of carcinoma as a part of an epithelial hyperplasia, have occasionally led to radical amputations of breasts unnecessarily, and also have allowed tumors which were clinically benign to remain in the presence of a possibility of malignancy.

The fact that general pathologists have recognized only epithelial hyperplasia into the stroma as carcinoma has led to advice to

[1] Read before the Southern Surgical and Gynecological Association, Atlanta, December 16 to 18, 1913.

the surgeon which has often proved to be disastrous.

The dogmatism relative to the rôle which the very indefinite "basement membrane" has played, in being the histological arbitrary line of demarcation between benign conditions and malignant conditions, has often retarded surgical radicalism which is, with our present knowledge, absolutely necessary in the treatment of cancer.

These existing conditions have stimulated a series of investigations of the pathology of one thousand breasts. It has been thereby shown that there are three definite histologic pictures which form a logical basis upon which operative procedure may be carried out.

The mammary acinus (gland unit) (Figs. 1, 2, and 3) is composed of one row of columnar or cuboidal epithelial cells, which are the functionating or secretory cells.

These rest upon another layer of cells which are almost invisible in the normal breast, but which become prominent when there is a chronic inflammatory reactive process present (Fig. 3). These correspond to the so-called "stratum germinativum" of the skin, and are the cells which are the progenitors of the differentiated or secretory cells. They constitute the germinal cells of the epithelium of the breast. In the presence of chronic inflammatory reaction in the mammary, one or more of three histologic pictures (Figs. 2, 3, 4, 5 and 6) are seen, whether the condition be encapsulated or non-encapsulated.

When the differentiated cells (inner row) and the undifferentiated cells (outer row) are present, the histologic picture may be spoken of as *primary epithelial hyperplasia* (Figs. 2a and 3). When the differentiated cells are absent and there remain only the hyperplastic undifferentiated cells of the outer row, the condition may be referred to as *secondary epithelial hyperplasia* (Figs. 2b and 4). When the line of demarcation between the hyperplastic undifferentiated cells and the stroma is indefinite or absent and the epithelial cells appear in the periacinar stroma, the condition may be spoken of as *tertiary* or *migratory epithelial hyperplasia* (Figs. 2c, 5, and 6).

Primary epithelial hyperplasia represents the usual reaction in chronic mastitis and is not considered to be malignant.

Tertiary hyperplasia or migratory hyperplasia is the histologic picture of carcinoma.

Secondary hyperplasia is found described as "cystadenoma," "Schimmelbusch's disease," "Reclus' disease," "senile parenchymatous hypertrophy," "abnormal involution," etc. It may or may not be malignant, it is placed in a benign group by some authorities and in a malignant group by others.

The cells of the epithelium in this condition are often indistinguishable from the cells in tertiary hyperplasia, a characteristic which arouses a suspicion that the two conditions are intimately related if not a part of the same thing, namely, a malignant hyperplasia.

Without proof relative to the outcome in such a condition, one may state that secondary epithelial hyperplasia is a doubtful condition, a group which needs special attention during the next decade.

The practical application of a knowledge of the three apparent histologic stages of hyperplasia may readily be seen in the fact that the life history of the most common pathologic conditions in the breast depends upon epithelial hyperplasia.

Mammary pathological conditions divide themselves into two groups, i.e., an encapsulated group (Fig. 7) and a non-encapsulated group (Fig. 8).

The encapsulated conditions to which special attention has been given during this investigation are the fibro-epithelial neoplasmata, such as simple adenomata, adenofibromata, fibro-adenomata, and cysts, in all of which epithelial hyperplasia occasionally occurs in all three stages.

Of the non-encapsulated conditions the most common is chronic mastitis, in which primary, secondary, and tertiary hyperplasia are also frequently found in the same field of the microscope.

With the possibility of these conditions being present in cases in which the classic clinical signs of carcinoma are absent, the surgeon and the surgical pathologist must agree upon a scientific histological standard before any definite operative procedure will bring about scientific knowledge of prognosis.

THE MAMMARY GLAND.

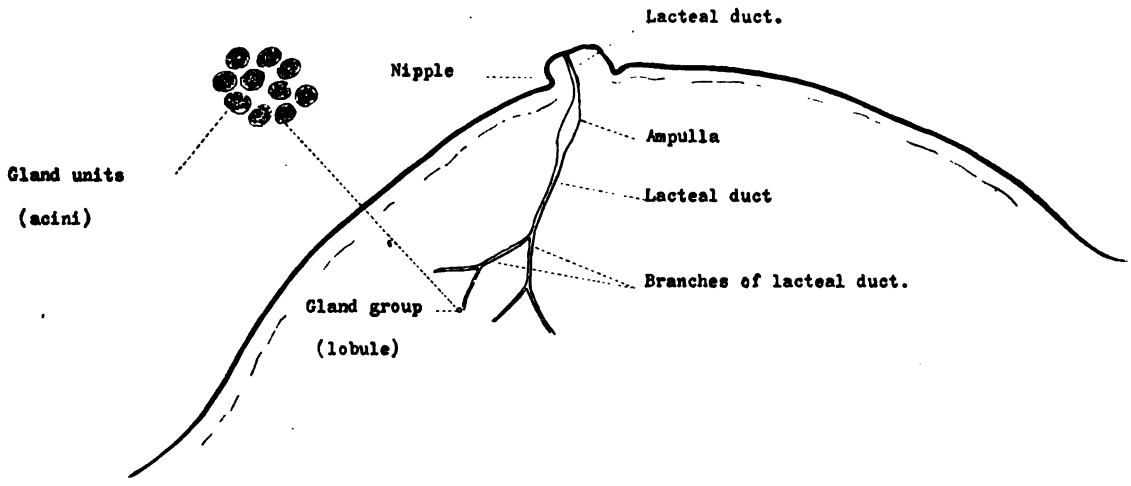



Fig. 1. Diagram of the mammary gland.

Primary epithelial hyperplasia (not carcinoma).

Secondary epithelial hyperplasia (carcinoma ? ).

Tertiary or migratory hyperplasia (carcinoma).

Fig. 2. Diagram of the mammary acinus in, *a*, primary; *b*, secondary (carcinoma?); and *c*, tertiary or migratory (carcinoma) epithelial hyperplasia.

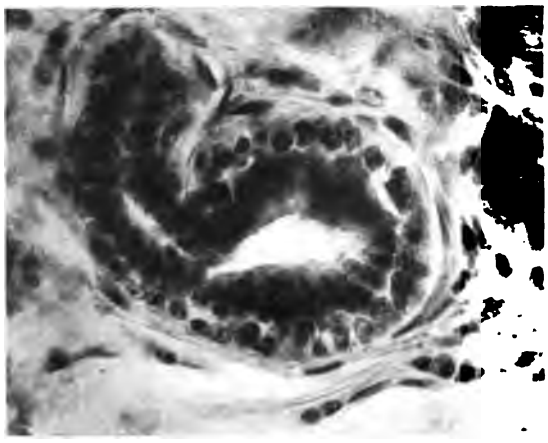


Fig. 3. Primary epithelial hyperplasia.

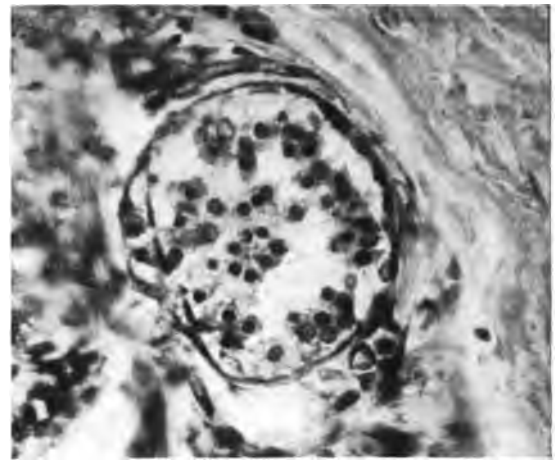


Fig. 4. Secondary epithelial hyperplasia (carcinoma?).

At present, surgeons have no very definite method or standard of dealing with the doubtful group. Radical operations are sometimes done when they are not needed, simply because the surgeon gives the patient the benefit of the doubt. The writer has occasionally seen carcinomata excised for benign tumors.

It seems that there should be a mean between the two extreme conditions, and this mean should, with the aid of a knowledge of the stages of epithelial hyperplasia, serve to scientifically solve the following problems:

1. The percentage of cases of tertiary hyperplasia with or without glandular involvement which may be cured after an arbitrary period of ten years from the time of radical operation.

2. The percentage of cases of secondary hyperplasia which will remain well or recur after the removal of the mammary gland itself without the removal of the glands, muscles, and large amounts of skin.

3. The percentage of cases with local chronic mastitides or encapsulated conditions which return later with secondary or tertiary hyperplasia after local removal.

The question for the surgeon to decide is whether or not he is willing to run the chance of local recurrence after wide local removal of a malignant condition followed by an exten-

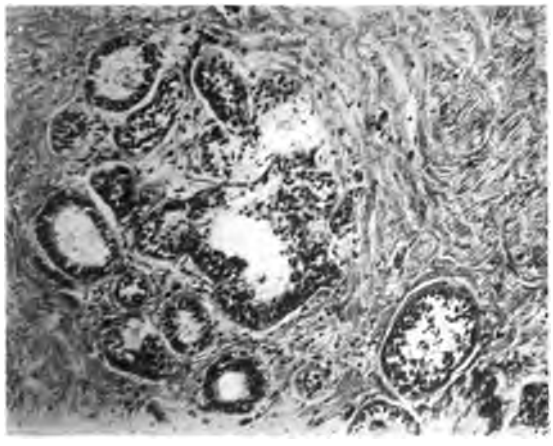


Fig. 5. Tertiary epithelial hyperplasia (carcinoma).

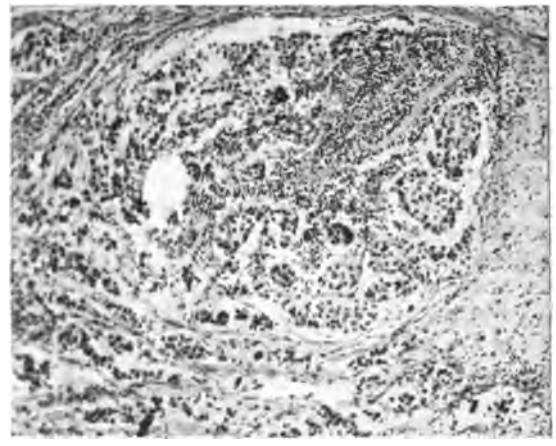


Fig. 6. Tertiary epithelial hyperplasia (carcinoma).

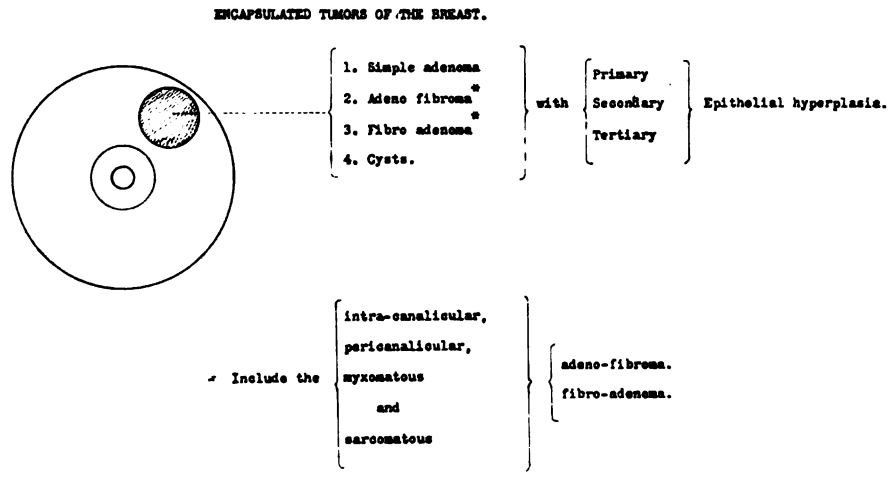



Fig. 7. Diagram of encapsulated mammary conditions.

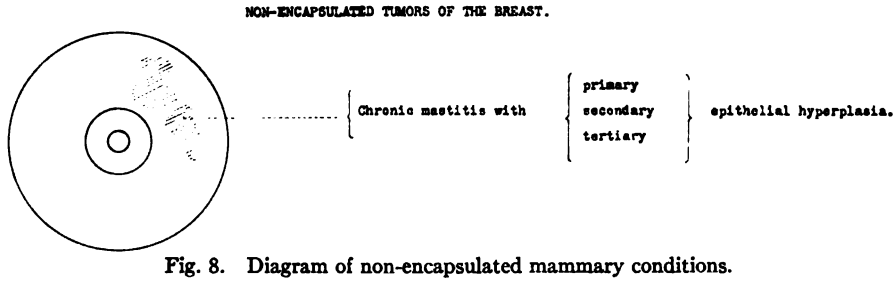



Fig. 8. Diagram of non-encapsulated mammary conditions.

sive operation after microscopic examination, or take the credit of doing radical operations unnecessarily in an attempt toward conservatism. This, with our present knowledge, can only be answered by conscience, and not by scientific data.

The plan which suggests itself to the writer, after an extensive experience with the pathologic conditions to be dealt with and also an intimate association with the activities of surgeons, seems to be based upon some known factors relative to the histology of epithelial activities and the fact that surgeons differ regarding the extent of operations necessary in the conditions which have been described above.

1. The conditions which are associated with classical clinical signs of carcinoma should be treated radically.

2. The doubtful cases in women near or over 35 years of age should have the entire mammary gland removed for immediate examination. If primary or secondary hyperplasia be present, nothing more should be done; if tertiary hyperplasia be present, a radical operation should be performed.

3. In doubtful patients near or under 35 years of age, a wide section of the mammary gland including the pathological conditions should be removed for examination. If primary hyperplasia be present, nothing more should be done. If secondary hyperplasia be present, the rest of the mammary gland should be removed; and if tertiary hyperplasia be present, the radical operation should be accomplished.

This plan avoids incision of tumors. It removes the possibility of unnecessary radical operations and their physical and psychical embarrassment. It provides for a scientific means of determining more accurately the stage at which cancer may be cured by surgical operations and the extent of the operation which is necessary to effect such a cure.

In the experience of this clinic the removal of the mammary gland preceding an immedi-

ate radical operation has not been associated with earlier recurrence that has been found after a primary radical operation.

The plan is herewith presented with the realization that it is a conservative experiment which is based on scientific facts. It is based upon actual research upon each specimen, and is free from the incumbrances of extensive terminology and dogmatism relative to which specimen is and which is not carcinoma.

It presents a means of actually determining what is clinically malignant.

It makes the surgeon an essential factor in the study of the biology of the epithelial cells and their relation to cancer. It will save many patients from unnecessary mutilation and will give radicalism its proper place in the treatment of cancer of the breast.

---

# END-RESULTS IN OPERATIONS FOR CANCER OF THE BREAST[1]

By E. S. JUDD, M. D., assisted by W. E. SISTRUNK, M. D., Rochester, Minnesota

THE following is a review of the results of operations in our clinic for cancer of the breast from January 1, 1902, to January 1, 1912.[2] It was originally intended to report all the cases of mammary cancer that had been operated on more than three years earlier, but in spite of the fact that we have endeavored for several years, through correspondence and personal communication, to complete our post-operative records, so far accurate data in many of the earlier cases have not been obtained. It seems best, therefore, to make this report cover the results of the ten consecutive years up to two years ago, of which we have fairly correct knowledge, hoping to be able to complete the data on the earlier cases at some future time.

Previously, it was customary to allow three years to elapse before making claims of a cure following an operation for cancer. It is undoubtedly true that many patients who pass through the first three years without recurrences do remain well, but it is also true that a certain percentage of them have recurrences and metastases at a period much later than three years. In view of this, it is difficult to say how much time should elapse before a patient operated on for mammary cancer may be said to be cured.

It is impossible to state what course these cases would have taken had they not been operated on, but, judging from the histories of similar though non-operated cases, it is fair to assume that a goodly proportion of those operated on reasonably early have either been cured or at least have had an extension of life and a comfortable existence for many years. "Cases not operated on prove fatal, on an average, in 20 to 28 months, the extremes varying from less than two months to more than 20 years:" Finney.

The cases upon which our study is based are consecutive cases, and none have been omitted from which post-operative data were obtained. Many operations were known at the time to be palliative, and were performed because of ulceration or the patient's extreme suffering. Many times these palliative operations were satisfactory, bringing relief and apparently prolonging life.

The principle in the technique of all the radical operations was practically the same, and consisted in the removal of the entire breast, axillary glands, and fascia, including the pectoralis major and minor muscles in every case. These structures were usually all removed in one piece. In the evolution of the operation, the tendency in the later years has been to remove more widely the subcutaneous and deep fascia in all directions. In some cases it has been necessary to skin-graft the wound in order to close it, though in most of our cases we have been able to suture the skin flaps directly. In many of the cases we employed technique as suggested by Jackson

[2] These operations were performed by C. H. Mayo, E. H. Beckman, E. S. Judd, and D. C. Balfour.

[1] Read before the Southern Surgical and Gynecological Association, Atlanta, Georgia, December 16 to 18, 1913.

and also by Rodman, and have found their methods very useful.

It has not been our practice to remove the fascia and glands from above the clavicle. If these glands are palpable, one is removed for microscopic examination, to determine the nature of the enlargement. If the supraclavicular glands prove to be involved, it has usually been our experience that the individual lives longer and more comfortably if not operated on. In some cases, however, especially when the lesion in the breast is in one of the upper quadrants, and especially if there be attachment to the skin, we believe that it is advisable to continue the dissection of the fascia and glands to the supraclavicular region. In most cases in which the glands were involved the individual has not lived three years. In one of such cases, however, the glands showed definite cancer, and the patient is now living (more than five years) without recurrence.

The diagnoses in all these cases were made from both macroscopic and microscopic evidence. During the ten years from January 1, 1902, to January 1, 1912, we have operated on 609 patients with cancer of the breast; of these 607 were females and two were males. One of the males is alive without recurrence three years following the operation. The other male died at the end of two years and eight months, from recurrence.

Of the 609 cases, we have been able to trace and have fairly accurate knowledge of 514. No patients in this series died in the hospital, though three died within one month after the operation. Patient No. A7541 died at the end of two weeks, when the wound was well healed; the autopsy in this case showed a large pulmonary embolism as the cause of death. Patient No. A46874 died at the end of the fourth week, in diabetic coma. The wound had healed and the autopsy showed no carcinoma. Patient No. A22134: Wound did not heal, patient developed septic phlebitis, dying at the end of fourth week from sepsis.

In estimating the age incidence of carcinoma of the breast, we found that the youngest patient was 25 and the oldest 85 years of age. Estimating the number of cases occurring in each decade, we find:

TABLE I

| | |
|---|---|
| 20 to 30 years of age | 13 patients |
| 30 to 40 years of age | 147 patients |
| 40 to 50 years of age | 228 patients |
| 50 to 60 years of age | 147 patients |
| 60 to 70 years of age | 88 patients |
| 70 to 80 years of age | 27 patients |
| 80 to 90 years of age | 1 patient |

In one patient 26 years of age, a tumor in the lower inner quadrant of the right breast was supposed to be benign, but at the time of removal it proved to be cancer. The wound was packed with gauze saturated with Harrington's solution, and two days later a radical operation was performed. This patient is alive and without recurrence seven years and nine months after the operation.

One patient, 25 years of age, whose tumor was diagnosed as malignant intracystic papilloma, at the time of the operation was nursing a 9-month-old baby. She is alive without recurrence more than six years later.

One patient, 28 years of age, with carcinoma of the left breast and concerning whom the prognosis at the time of operation was considered good, except for her age, is well now after three years and three months.

One patient, 26 years of age, diagnosed as early cancer of left breast, is alive with questionable local recurrence two years and nine months after operation.

One patient, 28 years of age, with cancer of the right breast and axillary glands, recurring after a partial removal of the breast elsewhere one year before, is alive without recurrence two years and nine months after operation.

These cases are mentioned especially to show that mammary cancer in a young person is not necessarily hopeless, and that a good percentage of the cases coming for treatment early may be relieved for a long time, and that even in recurring cases a fair result may sometimes be obtained.

As will be seen from the table, many of our cases have occurred in the so-called cancer age — 40 to 50 years — and by far the greatest proportion between 30 and 60 years. Nearly all the younger patients who remained well have been those who came for treatment early, before there was any evidence of extension to the lymphatics.

TABLE II

*Percentage of deaths according to ages*

| | Ages | Based on number of patients heard from. Died within 1 yr. | Died within 3 yrs. | Died wthin 5 yrs. | Died after 5 yrs. | Alive 2 to 10 yrs. |
|---|---|---|---|---|---|---|
| Total preclimacteric periods | 20–30 | 0 | 0 | 0 | 0 | 5 pat's |
| | 30–40 | 20% | 46% | 55% | 1% | 43% |
| | | 19% | 43% | 52% | 1% | 47% |
| Total climacteric periods | 40–50 | 20% | 45% | 50% | 5% | 43% |
| | 50–60 | 16% | 45% | 57% | 1.8% | 41% |
| | | 19% | 45% | 53% | 4% | 42% |
| Total post-climacteric periods | 60–70 | 16% | 37% | 44% | 7% | 43% |
| | 70–80 | 7% | 50% | 50% | 7% | 43% |
| | 80–90 | 0 | 0 | 0 | 0 | 1 pat. |
| | | 13% | 39% | 45% | 7% | 48% |

In Table II may be seen the percentage of cases for each decade who have died within the first year after operation. We cannot explain why the younger patients have apparently done better than the older ones, except that the great majority of them came for treatment early.

TABLE III

*Results in patients operated on over periods of three years*

510 patients operated on more than three years.
427 patients have been traced.
234 patients have died.
191 patients are living.
44.7 per cent of patients have lived more than three years.
27 of these patients have recurrence at the present time.
19 patients died from other causes.

Of the 514 patients whom we have been able to trace, 266, or 51.7 per cent, are known to be dead. Twenty-one of these died from other causes, without clinical signs of recurrence. On several of these patients autopsies were performed and no recurrence was found. Subtracting these from the number who have died from cancer leaves 47.6 per cent of deaths from cancer for the entire series. Of the 514 patients, 248 are known to be alive from two years to eleven years and four months. Thirty-seven of those living are known to have recurrences.

In 1902, 24 patients were operated on. Of those operated upon more than 11 years, we have traced 19: 15 have died from various causes and 4 are alive and have no recurrences. Thus, 21 per cent of this series are now alive, after more than eleven years, and without recurrence. In each of these patients the carcinoma was in the left breast. The axillary glands were enlarged in two of them. One of this series who died had had a fairly radical operation elsewhere twelve years before. She came to us with recurrence in the skin and axilla. This was removed and she lived two years and two months following this operation. One of these early patients lived six years and nine months after the operation, and died of arteriosclerosis, without evidence of recurrence. One other lived six years without local recurrence, and died of metastases in the liver.

Twenty-six patients were operated on in 1903. Of this group we have been able to trace 21, and 43 per cent are alive without recurrence. All of these patients have lived more than ten years. Two in this series had been operated on for malignant disease in other organs. One patient had had a hysterectomy for carcinoma of the uterus two years before, and one other had been operated on three months before for malignant papillary ovarian cysts.

*Patients living more than ten years.* Of the patients operated on during the years 1902 and 1903 we have been able to trace 40; of these, 27 are known to be dead from various causes, which leaves a percentage of 32.5 per cent alive without recurrence more than ten years. Three of the patients who died lived more than six years, and died from other causes.

*Patients living more than five years.* Of the 321 patients operated on more than five years, 266 have been traced. Of these 148 are known to be dead and 106 are living, thus giving a percentage of 39.8 living more than five years. Six of these patients have recurrence at the present time. Fourteen included in these deaths have died from other causes.

*Patients living more than three years.* Of the 510 patients who have been operated on more than three years, 427 have been traced; 234 are dead and 191 are living, leaving a percentage of 44.7 of patients living more than three years. Of these, 27 have recurrences at the present time; 19 are known to have died from other causes.

*Late recurrences.* We have also in this series several who have died from carcinoma

after being free from it for a number of years. In one instance the patient died nine years and one month after the operation from general carcinosis. One had metastases in the lungs five years and eleven months after operation. One had internal metastases in the liver six years and four months; another had metastases without any local recurrence, and died six years and five months after operation. In one instance we operated for recurrence twelve years after the primary operation, the patient remaining well nearly three years after the secondary operation.

We have known for some time that late recurrences occur following operations for carcinoma of the breast, but we have been rather surprised to find so many patients with late recurrence. In reviewing the literature on this subject, we have found one case reported by Matas with recurrence nearly 25 years after the first operation; and another reported by Ransohoff in which there was recurrence nearly 20 years after the primary operation.

Our statistics do not bear out the supposition that excision of the tumor or a part of the breast, followed by a radical operation within a few days or weeks, means always a bad prognosis. For example, in one of our cases the breast was removed for supposed mastitis. This was found on examination in the laboratory to be carcinoma. It is our custom in such cases to arrange for an immediate radical operation in all instances if it is found to be necessary. In this particular instance, however, the radical operation was not performed until seventeen days after the incomplete operation. This patient is now living without signs of recurrence seven years and nine months after the operation. In another case, a specimen had been removed one week before the patient came to our clinic, and at operation definite carcinoma of the breast was demonstrated. This patient at the present time is alive and free from recurrence, six years and two months after the operation. In one other case which is still more striking, the patient's breast was removed elsewhere four years before. Some weeks after this operation she developed nodules in the axilla. These were treated by X-ray over a period of some months. We removed the recurrent masses, and she has been living now six and a half years without further evidence of cancer.

On the other hand, we have had five cases in this series in which specimens had been removed elsewhere from three weeks to one year before our radical operation, and all these patients died, from two months to two and one-half years later.

We have had several patients in whom both breasts were involved. If both were involved at the same time, the prognosis as a rule was bad. If one had been removed and there was recurrence later in the other breast, the prognosis was often quite favorable. In 1905 we operated on a patient whose opposite breast had been removed in 1899. She lived four years eight months after the second operation.

In 1906 we operated on two patients in whom there was a very small lesion in the breast, and no glandular involvement could be found. Macroscopically and microscopically the diagnosis was early carcinoma, and we believed both were favorable cases. Both of these patients had early metastases, and one died within two years. These two patients seem to illustrate a certain group who in all probability, at the time of operation, have internal metastases or extension to the mediastinal glands without evidences of such extension. We have seen several hopeless cases because of metastases to the liver, spine, or bones, and yet in which the primary focus was small and free, and no enlarged glands could be felt.

We have also observed two such patients with pathological fractures of the femur. In both of these the fractures occurred five years after the operation. Metastasis to the bones has not been common, though many of the replies to our inquiries would indicate involvement of the vertebræ. Involvement of bone is usually late.

We have considered œdema in the tissues as a contra-indication to operating, because we believed that the lymphatics were all blocked by the extension of the cancer. One of these patients, in whom the prognosis was bad because of œdema and who was operated on as a palliative measure, is yet alive without recurrence five years and three months later.

Cancer in the lactating breast has been most unfavorable. Of the three patients operated on, two have died within the first year; in the one exception, the growth was an intra-cystic papilloma.

TABLE IV

*Results in patients operated on over periods of five years*

321 patients operated on more than five years.
266 patients have been traced.
148 patients have died.
106 patients are living.
39.8 per cent of patients have lived more than five years.
6 of these patients have recurrence at present time.
14 of these patients died from other causes.

TABLE V

*Results in patients operated on over periods of ten years*

50 patients operated on more than ten years.
40 patients have been traced.
27 patients have died.
13 patients are living.
32.5 per cent of patients have lived more than ten years.
None of these patients have recurrence at the present time.
3 patients died from other causes.
All of these three patients lived more than six years.

TABLE VI

*Number of cases and percentages for each year*

| Year | No. of Cases | Traced | Dead | Alive, no Recurrence | Alive, with Recurrence | Alive, no Recurrence | Alive, with Recurrence |
|---|---|---|---|---|---|---|---|
| 1902 | 24 | 19 | 15 | 4 | 0 | 21% | |
| 1903 | 26 | 21 | 12 | 9 | 0 | 43% | 0 |
| 1904 | 32 | 24 | 14 | 10 | 0 | 41.7% | 0% |
| 1905 | 51 | 43 | 23 | 18 | 2 | 41.8% | 46% |
| 1906 | 57 | 51 | 34 | 17 | 0 | 33⅓% | 0% |
| 1907 | 62 | 50 | 28 | 20 | 2 | 40% | 44% |
| 1908 | 71 | 59 | 34 | 23 | 2 | 39% | 42.3% |
| 1909 | 94 | 79 | 42 | 29 | 8 | 36.7% | 46.8% |
| 1910 | 95 | 82 | 34 | 35 | 13 | 42.7% | 58.5% |
| 1911 | 97 | 86 | 30 | 46 | 10 | 53.5% | 65% |

*Functional result.* Special inquiry has been made regarding the ability to use the arm and shoulder following these operations, and a very large percentage of the patients have reported that their arms are all right or practically as good as ever. We have noticed that when it is necessary to destroy one of the motor nerves the function is much more apt to be impaired. Pain in the arm is usually complained of shortly after operation, but in most of our cases this entirely disappears within two weeks. We have made special inquiry regarding œdema in the arm. Occasionally the swelling and œdema has been marked. Counting the patients with the œdema and those who say they have some swelling of the arm at times, the entire group is not over 5 per cent. The œdema, as we have seen it, occurs in two ways: first, as primary œdema immediately following the operation. This is quite common, and we believe it is due to a thorough removal of the lymphatics; it persists until collateral circulation in the lymphatics has been established. This is usually a matter of two or three weeks, and can be relieved by early exercise and massage. Second, are those patients in whom the œdema comes on late, several months or years after the operation. Here it is due to a recurrence of the carcinoma in the remaining lymphatics, which have been draining the arm, and of course is permanent. In four patients we have removed the entire axillary vein down to the cephalic vein, taking care that the latter was not injured. The resulting œdema was but slight and temporary. Even with the removal of the pectoral muscles, intercostals, part of the latissimus dorsi and serratus magnus, and all of the axillary fascia and lymphatics, in many of these cases the function of the arm and shoulder has been impaired very little.

CONCLUSIONS

1. Results in operations for cancer of the breast are as good as if not better than results in operations for cancer elsewhere.

2. The prognosis in younger people who received the benefit of an early operation was better than we had expected.

3. The prognosis is variable in a certain per cent. An extensive external involvement may give a fair prognosis, while a slight external lesion may terminate early from internal metastasis.

4. That metastasis may occur many years after the operation, though in the great majority of instances it will appear in the first few years, if at all. The difference

between the percentage of patients living more than three to five and ten years is not as great as might be expected; but this is because most patients who die of the disease die within the first three, or at least the first five years. Living five years without recurrence is an indication of but slight trouble in the future.

5. Comparing these results with those of former years, we feel that the results are improving, and that the improvement seems due to the fact that patients are coming earlier rather than to any improvement or change in the technique.

REFERENCES

FINNEY. Keen's Surgery, 1908, iii, 603.
JACKSON. J. Am. M. Ass., 1910, liv, 178.
MATAS. Quoted by Ransohoff, Tr. Am. Surg. Ass. 1907, xxv, 193.
RANSOHOFF. Tr. Am. Surg. Ass., 1907, xxv, 187.
RODMAN. J. Am. M. Ass., 1909, lii, 1648.

# GASTRIC HÆMORRHAGE [1]

BY JOHN B. DEAVER, M. D., PHILADELPHIA

GASTRIC hæmorrhage or the copious effusion of blood into the stomach is, as a rule, followed by hæmatemesis, and results from a number of disturbing factors in the mechanism of the upper abdominal circulation. In the minority of cases the blood is not at once ejected, but is passed subsequently by the bowel in the form of tarry stools. Cases of gastric hæmorrhage fall into two groups, the surgical and the non-surgical or medical. It is as great a mistake to operate on non-surgical cases as it is to withhold operation in surgical bleeding. The exploratory operation, therefore, is not available for diagnosis, and successful treatment demands a high degree of diagnostic skill in deciding for or against operation.

It is well to bear in mind that blood which is vomited does not always mean gastric hæmorrhage. The older clinicians called forcible attention to hæmatemesis as a symptom of hæmorrhage from the pharynx or respiratory tract, the blood being swallowed and later vomited. I have seen profuse hæmatemesis in hæmorrhagic inflammation of the biliary tract, the blood having reached the duodenum through the common duct and then regurgitated into the stomach. The primary cause in this case was acute streptococcic cholecystitis. One case of carcinoma of the jejunum was characterized by profuse hæmatemesis. Profuse hæmorrhage from a duodenal ulcer not infrequently is carried backward into the stomach, and after a gastro-enterostomy a marginal or jejunal ulcer may bleed into the stomach. The examination of all the rare causes of hæmatemesis would serve here no useful purpose. Most often, true gastric hæmorrhage is due to ulceration of the stomach. The ulceration may be due to malignant disease or to a benign process. It may be acute or chronic, superficial or deep, large and extensive or microscopically small.

Profuse and even fatal hæmatemesis without demonstrable ulceration of the stomach has been observed in a considerable number of cases, both at autopsy and at operation. Dieulafoy has described a variety of hæmorrhage due to the formation of minute mucous erosions, single or multiple. Such erosions have been observed as linear or stellate fissures in the act of bleeding during operation. Paterson reports a case in which no visible erosions were present, but a raised vividly red patch of mucosa the size of a half-crown was seen to be oozing blood. I have observed a case by gastrotomy in which the whole mucosa was intensely red and thick and bled at the slightest touch. Such a condition I am inclined to consider as a hæmorrhagic gastritis, and it is probable that it is the result of an intense acute infection of the mucosa, though it may be due solely to an unknown toxic cause. Of 459 of our

[1] Read before the Clinical Congress of Surgeons of North America, Chicago, November 11, 1913.

cases of upper abdominal disease, hæmatemesis occurred in only 25 per cent, and 20 per cent of these cases were either simple ulcer or cancer of the stomach.

Vicarious menstruation as a cause of hæmatemesis is an absurdity of the medical imagination, more fertile in hypothesis than wise in the knowledge of living pathology.

A knowledge of the hæmorrhagic possibilities of active congestion of the gastric mucosa cannot be learned at the mortuary slab, but only by witnessing its bleeding surface in the living.

The touch of the surgeon during life, as Mayo has so well said, has revealed that which post-mortem pathology has overlooked. Profound knowledge of the pathological anatomy of the conditions giving rise to gastric hæmorrhage is only gained by autopsy *in vivo*, which knowledge is as essential to the making of a diagnostician as it is to go into the water to learn to swim. Internists will never be alive to the possibility of ulcerative pathology until they have been made familiar with an eye demonstration in the living subject.

Excepting extrinsic poisons, I believe this violent congestion of the gastric vessels is primarily dependent upon an intra-abdominal or more rarely a remote focus of infection. I believe, further, that the atrium of infection in these cases is most commonly the appendix, the gall-bladder, the fallopian tube, and more rarely some other storehouse of bacterial growth. This variety of acute massive hæmorrhage from the gastric mucosa without evident ulcer occurs most often in young females. Exceptionally it has been noted in males and at the older ages. It is distinguished chiefly by the age and sex incidence, by the suddenness of onset and freedom of the hæmorrhage, by the usual absence of previous ulcer symptoms, and by spontaneous recovery in the majority of instances. Mansell Moullin, in 1907, stated that he had observed 153 cases of hæmatemesis due to supposed gastric ulcer occurring in females under 30 years of age, with only one death. He believed his experience was exceptional in respect to mortality, but Bramwell, in almost as large a series of cases belonging chiefly to this group, experienced a mortality under medical treatment of only 3 per cent. Hale White has reported 29 cases of hæmatemesis in which post-mortem examination revealed no gastric lesions, and suggested for the condition the name gastrostaxis. Dawson contributed two cases, and preferred the term hæmorrhagic gastralgia. While I have never operated upon this condition during acute bleeding, it has fallen to my lot to explore the stomach in a number of cases in which a history of hæmatemesis and some sort of indigestion had indicated the probability of ulcer, without being able to demonstrate any lesion, past or present. Even allowing for the well-known difficulty of demonstrating erosions or fissures by operation or autopsy, I believe it is clear that there is a hæmorrhagic disease of the stomach which is not any form of gross ulcer and probably is not closely related to it. Bramwell gives a suggestive case of hæmatemesis in which the underlying condition of vegetative endocarditis gave little indication of its presence during life. It appears to be clear also that the toxic or infective influences which cause this variety of hæmatemesis are not materially improved by operation upon the stomach. In ten cases of acute hæmorrhage in which no lesion was demonstrated at operation, there was one operative death and two cases of recurrence of bleeding. We must, therefore, yield to the results of experience and eliminate this group from operative endeavor.

The condition of mucous erosions described by Dieulafoy has been established as a true pathological condition by the actual observation of such erosions in the form of linear or stellate fissures in the act of bleeding during operation. Whether this condition stands most closely in relation to hæmorrhagic gastritis or to acute peptic ulcer, it is not yet possible to determine. Clinical evidence does not suffice, and living pathology has not yet dispelled the mystery. Such erosions may bleed furiously, even to the point of exsanguination and death. In the past ten years I have found in the literature six such patients treated by gastrotomy and ligature of bleeding points of the mucosa. In one case a gastrojejunostomy was added. There

were no deaths; but the number of cases is small, and it is hard to resist a feeling that in view of the diffuse nature of the disease the recoveries that followed such simple measures cannot justly be given too large a measure of credit. It is highly probable, moreover, that at least a percentage of cases regarded as gastrostaxis belong in this group. I have operated upon six cases in this group without mortality. The operations were gastrotomy for exploration, gastrojejunostomy, and plication of the duodenum for relief. The immediate results were excellent, but I have not been able to follow all of the cases. My belief in the necessity of the operation in this class of cases has been considerably undermined by the good results of medical treatment. I do not believe that gastrojejunostomy should be performed in the absence of gross gastric lesions.

Hæmorrhage, more or less acute, may result from the formation of the typical acute peptic ulcer, the vessels beneath the muscularis mucosa being opened by the ulcerating process. Such hæmorrhage is rarely fatal, the vessels opened being small and their walls still soft and normal, permitting retraction and contraction with the formation of an occluding clot as the blood pressure is reduced by hæmorrhage. In many cases acute ulcer announces its presence by bleeding, and if appropriate measures are taken the hæmorrhage is rarely dangerous and seldom repeated.

In chronic ulcer, as pointed out by Fenwick, the vessels eroded may be larger, and as a result of the sclerosing inflammatory process which has preceded the actual erosion, the vessel wall is rigid and incapable of contraction. Hæmorrhage from this source, therefore, is apt to be free, and if stopped temporarily by the fall of blood pressure and clot formation, it is prone to recur from digestion of the clot and advancing erosion.

While it is true that sudden massive hæmorrhage does occur in chronic gastric and duodenal ulcer, it is also true that it is not a characteristic of ulcer to bleed profusely. Occult blood or small recurring hæmorrhages are far more characteristic of ulcer, and it is therefore incumbent upon the diagnostician, in the presence of diffuse hæmatemesis, to adduce considerable evidence in the way of history or examination before concluding that ulcer is present.

Sudden profuse hæmorrhage is more characteristic of ruptured varix than of gastric ulcer. Varicose veins about the cardia have long been known as a condition associated with cirrhosis of the liver, and are likely to cause death by sudden rupture. This condition is met with chiefly in males who are or have been addicted to the habitual or excessive use of alcoholics. Indigestion is a common complaint in cirrhosis, but it is rarely of the ulcer type. The distinguishing feature of this hepatic indigestion is a feeling of fullness in the upper abdomen, a feeling of constriction, which is constant but much increased after the ingestion of meat. This is not associated with pain simulating ulcer, with any evidence of gastric fermentation, with eructations of gas, or with any suggestion of alteration in the motility of the stomach. This is simply the subjective impression of an overdistended portal circulation analogous to the gastric discomfort of non-compensated lesions of the mitral valve. On the insistence of three medical colleagues, I recently operated upon a middle-aged man whose recital of this symptom, rather than the associated hæmatemesis, led me to disagree with their diagnosis of duodenal ulcer. This patient's history lacked the pain typical of ulceration; indeed, there were few symptoms, except several attacks of hæmatemesis and the peculiar hepatic indigestion to which I have referred. Operation showed a cirrhotic liver — not ulcer. Ten days after the operation the patient succumbed to a fatal hæmatemesis. Autopsy revealed a perforated varicose ulcer of the lower end of the œsophagus. Cases are occasionally met with in which none of the usual etiologic factors of cirrhosis exist, and the signs may be no less obscure. Taylor has reported such a case, in which gastro-enterostomy was done in the belief that ulcer existed. There was slight temporary improvement, followed by recurrence of the bleeding and death. Not long ago a similar case came to us for hæmatemesis, who had had a gastro-enterostomy

done previously by one of my Philadelphia colleagues. I refused to operate, believing the case one of cirrhosis. Patient recovered and has since been at the hospital for similar attacks. I have found no cases in the literature in which a gastric drainage operation has benefited, for any appreciable length of time, the hæmorrhage due to cirrhosis of the liver. The cirrhotic is a poor subject for surgery, even exploratory, and the futility of surgery in the emergency of hæmorrhage from œsophageal varices is the cause of considerable chagrin to the surgeon who opens the abdomen for the cure of this variety of hæmorrhage. Of 149 cases of cirrhosis of the liver admitted to the medical wards of the Episcopal Hospital of Philadelphia, 6 per cent gave a history of bloody vomitus.

The hæmorrhage due to malignant disease of the stomach, like that of ulcer, is not commonly sudden and profuse. In the early stages it is slight, even occult in the stools. It is more likely to be persistent than the hæmorrhage of ulcer, and tends to become progressively more marked. The hæmorrhage from malignant ulceration is, as a rule, a slow seepage which gives rise to little systemic effect of bleeding, but reveals itself by the process of coffee-ground vomitus or melæna. Sudden hæmorrhage is one of the modes of termination of gastric carcinoma, but in all but the rarest instances such an event is but the termination of an already established and evident malignant cachexia.

When hæmorrhage is a result of neoplasm it is rarely remediable by surgery, though occasional success may be attained in the case of slowly metastatizing malignant growths or in ulcerated benign tumors of the stomach. During the past year there occurred in the practice of one of my Philadelphia colleagues a case of death from hæmorrhage of an ulcerated myoma of the stomach. The growth was round, encapsulated, and about 6 cm. in diameter, and its growth was chiefly inward into the cavity of the stomach, much like a submucous myoma of the uterus. On the innermost surface a typical punched-out round peptic ulcer had formed, from which successive hæmorrhages reduced the patient to a condition of such anæmia that the case was regarded as one of the pernicious variety, with bleeding from the mucosa of the intestinal tract. Autopsy revealed a tumor of the gastric wall, easily capable of excision.

Gastrorrhagia dependent upon blood dyscrasias must be kept in mind, although they rarely offer serious difficulties in diagnosis. Our understanding of active blood vascular congestion as a cause of profuse hæmatemesis is one of the monumental gifts of living pathology to clinical surgery.

Operation may be indicated in gastric carcinoma when hæmorrhage chances to be an early symptom and there is still hope of cure; or it may be indicated in advanced or otherwise inoperable cancer when hæmorrhage is so profuse and persistent as to shorten even the period of prognosis given to cancer. In this case the measures to be adopted are: excision, gastro-enterostomy, or jejunostomy, in accordance with the pathology found at operation. Kammerer has reported a case of gastric carcinoma with profuse hæmorrhage in which gastrojejunostomy stopped the bleeding and the patient lived almost a year. Tixier records a similar case in which hæmatemesis ceased after gastro-enterostomy, and he was able a month later to resect the growth. In my opinion, appropriate cases of this sort will be excessively rare, as I am greatly opposed to operations being done on cases which are inoperable from the standpoint of cure. I have seen too many instances where the expected benefit failed to materialize and the last state of the patient was worse than the first. And even in the case of temporary improvement, the subsequent disappointment is often but the more keen. The true interests of surgery, also, are retarded by what the laity considers a failure of our art, and attention is diverted from the crux of the question, namely, early diagnosis and treatment.

It would seem to me that sufficient observations have been accumulated concerning the prognosis of gastric hæmorrhage not due to trauma, with or without operation, to confine the indications for operation to one group of cases, namely, chronic benign

ulcer. It is beyond doubt that lives have been saved by surgical intervention in chronic ulcer. That the chronic ulcer which slowly erodes its way into an important vessel will, in the majority of instances, cause fatal hæmorrhage is established by clinical and pathological evidence. But four most essential questions remain to be settled: (1) The recognition of suitable cases; (2) the time to operate; (3) the type of operation to be performed; (4) the proof of our position by mortality statistics.

1. The diagnosis of chronic eroding ulcer must be clear to warrant operation in acute gastric hæmorrhage. Not only must the conditions which simulate it be considered and eliminated so far as possible, but we must be in possession of a history which points strongly toward the existence of chronic ulcer. The most important point is a history of long continued, persistent, painful indigestion definitely related to the ingestion of food. There should be a certain irregular periodicity, but the intervals of freedom from symptoms should be only weeks, not months or years. The methods of relief from pain are often important. The constant use of alkaline remedies, of additional food when pain comes on, of gastric lavage, point toward ulcer. In some cases small hæmorrhages have occurred previously, and in some fortunate cases the patient has already had a well-founded diagnosis of ulcer made by his medical attendant.

The surgeon must not be considered as the mechanician only, but particularly as the master diagnostician, made such by frequent excursions into the pathological fields with which the abdominal cavity is too often so rich. Like the internist, the surgeon must not pin his faith in obscure cases to the bismuth meal, the X-ray, and the fluoroscope, but to the aseptic scalpel which makes the abdominal wall transparent.

Granted that we are in the presence of an acutely bleeding chronic ulcer, when should we operate? Many of these hæmorrhages are so rapid and alarming that the patient when first seen is practically exsanguinated. Savariand stated that 18½ per cent of the victims of hæmorrhage died before operation was possible. In many others hæmorrhage ceases just short of death. It is manifestly improper to attempt operation in acute collapse. Surgical judgment must be invoked to determine the possibility of successful operation, and in general it is my opinion that we should err on the side of conservatism. As Paterson has pointed out, the low blood pressure and collapse of hæmorrhage is favorable for arrest of the bleeding but unfavorable for surgical intervention.

General measures for the treatment of internal hæmorrhage should be rigidly applied. Morphia hypodermically is the most valuable. Absolute quiet is essential. The foot of the bed should be elevated. Nothing, not even ice or a drop of water, should be given by mouth. Saline solution should be given by rectum, or in greater emergency by hypodermoclysis or intravenously. If death is not too imminent, fluid should not be supplied too quickly lest it raise the blood pressure, dislodge the clot, and favor further hæmorrhage by the dilution of the serum. The return of the patient to a normal circulatory condition should be carefully watched. In this point I would differ from the majority who wait for further hæmorrhage before deciding to operate. The shock of even a moderate acute hæmorrhage is temporarily great, but may be quickly recovered from. If we have the diagnostic evidence of chronic ulcer, it is at this point that operation should be undertaken. A second hæmorrhage is far more depleting than the first, and, moreover, throws but little light upon the pathology, which is the essential point at issue, since recurrent hæmorrhages are common in the other varieties of gastric hæmorrhage.

The chapter on the methods and results of operation we must all unite in making. The ligature remains the premier method of hæmostasis, but the advisability and necessity of its application in profuse intragastric bleeding becomes a matter of most refined discrimination between the several causes of such bleeding.

It is true these are rarely surgical emergencies in the sense that ruptured ectopic pregnancies are emergency cases, but to withhold the aseptic scalpel in a definite

proportion of these cases is a practice as erroneous as the gynecologic suggestion to await reaction in the dying woman. My experience has been fortunate in operative cases. I have operated upon 10 cases of acute gastric hæmorrhage. In 2 cases I excised the ulcer by pylorectomy; one recovered, one died. In 3 cases of duodenal ulcer I made a posterior gastrojejunostomy and plicated the duodenum over the ulcer. All recovered. Five cases of pyloric ulcer were treated by simple gastrojejunostomy. All recovered. Two cases of hæmorrhage have died in the wards during the past six years while reaction was awaited. In one the coronary artery was eroded, in the other the gastroduodenal was opened.

In reviewing the literature during the preparation of this article, 33 cases of operation for acute gastric hæmorrhage, exclusive of my own, were collected since the independent reviews of Tuffier and Connell in 1905. In these 33 cases there were 8 deaths (24.2 per cent). This is to be compared with Tuffier's collective mortality of 36.3 per cent in 1905, with Rodman's mortality of 37.5 per cent in 1901, and with Savariand's figure of 62.6 per cent in 1898.

It is easily seen that the mortality is continually becoming less, a fact attributable, doubtless, to various causes, but in part at least to increasing accuracy of recognition of the proper type of cases in which surgery is to be employed. May we not hope that our skill in diagnosis and resources of treatment may be so increased that we may be able to select and save a greater percentage of those who are seized with sudden gastric hæmorrhage? Many problems remain for surgical solution, but it must be our constant aim to build a symptomatic superstructure on the foundation of our knowledge of the living bleeding tissues. In this wise we can guide aright the steps of professional judgment, crippled with that irrationality inseparable from terminal or dead pathology.

---

# ON THE ETIOLOGY AND BACTERIOLOGY OF LEUCORRHŒA[1]

By ARTHUR H. CURTIS, M. D., Chicago

From the Memorial Institute for Infectious Diseases, aided by a grant from the Fenger Memorial Fund

OUR knowledge of leucorrhœa is unsatisfactory and incomplete. The majority of physicians neither appreciate the gross aspects of the condition nor discover the locality from which discharges arise, practically none of us possesses an adequate knowledge of the bacteria involved, and most clinicians admit that their curative efforts yield poor results.

This study was begun with the desire to learn more about the factors concerned in leucorrhœa, with especial reference to bacteriology, in the hope of thus leading to new principles in treatment.

The work includes the following subdivisions:

I. A consideration of where discharges originate.

II. The characteristics of leucorrhœal discharges.

III. The bacteriology of leucorrhœa. This embraces:

(1) Notes on the literature; (2) a brief description of the material used and nature of this study; (3) the characteristics of fresh smears and of cultures; (4) organisms of chief interest in the cases studied.

IV. Discussion and conclusions.

## I—WHERE DO DISCHARGES ORIGINATE?

It is essential to locate the focus of chronic infection with which the leucorrhœa is associated. Most physicians believe we have here to do with an infection of the uterus; hence the usual diagnosis of "endometritis" and the frequent use of the curette in the hope of effecting a cure through removal of the infected endometrium.

To determine whether uterine infection actually exists in leucorrhœal cases, cultures

[1] Read before the Chicago Gynecological Society, December 19, 1913. See discussion on p. 303.

were made from the uterus obtained at operation in several instances, as well as from scrapings from a dozen patients with leucorrhœa. Exclusive of two cases of pyometra, caused respectively by a fibroid polyp and by carcinomatous obstruction of the cervix, in no instance was a leucorrhœa-like discharge obtained from the uterus. Fresh preparations, as well as cultures, failed to reveal the presence of bacteria.

In over 20 patients the cervix was exposed to view and observed for evidence of leucorrhœal discharge, in many the cervix was dilated to assure free drainage during the period of observation, but in none was there evidence of anything more than a mucous discharge from the uterus.

These results, namely, the absence of bacteria in uterine scrapings from leucorrhœal cases, the negative results of cultures from the endometrium, and the failure of persistent attempts to discover a leucorrhœal discharge from the uterus, indicate that purulent discharges are formed in the lower genital tract and rarely consist of bacteria-laden material from the uterine cavity. Mucus, on the other hand, arises from the region of the cervix, especially when it is hypertrophied, everted, or eroded.

## II—CHARACTERISTICS OF LEUCORRHŒAL DISCHARGES

The flow is either ropy and mucoid (from the cervix) or of a purulent nature. An admixture of mucoid and purulent material is common. A purulent discharge may be thick and creamy or watery in character. Without assignable cause, a creamy discharge may become watery, or the reverse may be true; with decrease in the consistency there is, as a rule, a corresponding increase in amount. In some instances the quantity of flow is surprisingly great. Such patients are not only forced to make constant use of napkins, but find it necessary to change during the day to avoid soiling their linen.

Döderlein considers a weakly acid or alkaline reaction characteristic of leucorrhœa. I have most often encountered a frankly acid, much less frequently a neutral or slightly alkaline, reaction.

## III—BACTERIOLOGY OF LEUCORRHŒA

1. *Contributions to the literature.* The bacteriology of leucorrhœa has received but scant attention. Those studies which have touched on this question have been chiefly concerned with the part played by the vaginal flora in the production of puerperal infection.

In 1892 Döderlein[1] described his vaginal bacillus, the only organism he considers a normal inhabitant of the vaginal canal. This he found to be a non-motile, non-pathogenic, anaërobic, facultative aërobic bacillus, which forms drop-like colonies on glucose-agar. These bacilli of Döderlein really represent a class of similar large gram-positive bacilli, rather than one distinct kind of organism.

Menge and Krönig[2] made an interesting study of the bacteriology of the female genitalia. They did not, however, give special consideration to the bacteriology of leucorrhœa. The majority of bacteria in vaginal secretions they found to be anaërobes, some of which grow on acid media as facultative aërobes. Examination of aspirated material from the cervix and uterine cavity led to the conclusion that bacteria do not live in the normal uterine cavity, and the same holds true in most instances of chronic endometritis.

Wegelius[3] studied the bacteriology of post-partum discharges and classified the organisms found. Obligate aërobes, such as the pseudo-diphtheria bacillus, were present in the vulva, but rarely in the vagina. The coli group was represented in 40 per cent of cases, but it also was almost invariably limited to the vulva.

Heurlin[4] also carefully classified the bacteria found by him in febrile puerperal cases.

2. *Material and scope of study.* Seventy-five patients have been studied; of these 35 had profuse leucorrhœa. All were requested to re-

[1] Döderlein. "Das Scheidensekret und seine Bedeutung für das Puerperalfieber." Leipzig, 1892.

[2] Menge und Krönig. "Bakteriologie des weiblichen Genitalkanales." Leipzig, 1897.

[3] Wegelius. Bakteriologische Untersuchungen des weiblichen Genitalsekrete während der Entbindung, etc. Arch. f. Gynäk., 1909, lxxxviii, 249.

[4] Heurlin. "Bakteriologische Untersuchungen des Keimgehaltes im Genitalkanale der fiebernden Wöchnerinnen mit Berücksichtigung der Gesamtmorbidität im Laufe eines Jahres." Helsingfors, 1910.

turn for frequent examination, and to avoid douches and other sources of local contamination for some days preceding the cultures.

Material for culture was obtained from various parts of the vagina, notably from the vicinity of the cervix, a sterile vaginal speculum and platinum loop being employed in obtaining the discharge. Fresh preparations were also stained for study.

The discharges were cultivated on blood-agar and ascites-blood-agar, as well as on other media, under both aërobic and anaërobic conditions. Isolation of the various anaërobic strains was found to be impossible when only one series of dilutions was employed. The growth, therefore, on those tubes which showed most luxuriant development was reinoculated in varying dilutions upon fresh sets of media. In this way some organisms were isolated in the first set of cultures, while others were obtained in subsequent dilutions in subculture. It has been necessary to repeatedly obtain fresh material for cultures from almost every patient in order to isolate the various organisms present.

3. *Characteristics of fresh smears and of cultures.* The uncontaminated vaginal secretion contains a preponderance of large, gram-positive "vaginal bacilli" of Döderlein (Figs. 1 and 2). The usual case, however, yields a varying number of contaminating organisms. Mucoid secretion, notably in the absence of local inflammation, presents a picture which tends to agree with the normal.

In purulent discharges we find the greatest variations in flora and encounter much difficulty in classifying the bacteria present. In fresh preparations (Fig. 3) gram-negative bacilli tend to predominate. Gram-positive cocci are regularly present; they occur most often in pairs, and may vary considerably in size. Gram-negative diplococci, likewise varied in size, are less common and are less numerous when present.

A determination of those forms which are noxious as contrasted with those of minor importance requires a study and classification of the chief types of bacteria found in leucorrhœal discharges. Such a classification of bacteria common to leucorrhœa is not available and is unquestionably needed.

Anaërobic blood-agar slants show an elevated, roughly beaded, fairly well confined, but rich growth. Control aërobic slant cultures commonly develop poorly in comparison. Aërobic blood-agar plate cultures tend to yield a very poor growth.

From the characteristics of organisms as they appear in fresh preparations, also from the relatively rich growth in anaërobic cultures, as compared with control aërobic cultures, it is evident that the greater number of bacteria in leucorrhœal discharges are anaërobic in nature. It does not necessarily follow that fewer aërobic strains are obtained, for these are easier of cultivation. Many anaërobes, on the contrary, do not thrive on artificial media, and others which grow well in mixed culture cannot be isolated.

It is noteworthy that the cultures made from the vulvar region, in contrast with higher vaginal cultures, contain more aërobes, notably B. coli, staphylococci, and pseudo-diphtheria bacilli. Consequently, high vaginal cultures from patients who are subjected to frequent douching show contamination with similar bacteria, with profuse growth on aërobic media.

In order to observe the virulence of leucorrhœal organisms, animals were injected subcutaneously, intravenously, and intraperitoneally with the vaginal washings from four most pronounced cases. Noteworthy evidences of toxicity were not found. Several rabbits and guinea pigs injected with fresh cultures from similar material were likewise unaffected.

4. *Organisms of chief interest in cases studied.* It must be remembered that during the period of twenty months covered by this work the time-consuming character of the task has allowed a study of only 75 cases, 35 of which had well-marked leucorrhœa. Subsequent findings will enlarge the list of organisms and may be expected to somewhat alter the views concerning the significance of certain bacteria.

BACILLUS 1. Anaërobic cocco-bacillus (Fig. 4). Fairly plump bacilli, typically 2 to 3 microns in length. Extreme variations in length are common. Usually single, they also frequently are found in long chains in which successively occur coccus-

shapes, bacillus forms, and long thread-like varieties. Attempts to secure individual organisms were made by Dr. V. H. Moon, according to Barber's method, but were unsuccessful because of peculiar conditions of surface tension when in suspension. The bacillus is destained by Gram's method, but stains readily with the usual aniline dyes. These bacilli are often present in cases with profuse creamy discharge. Growth is obtained only under anaërobic conditions. Best development occurs on blood-agar and ascites-blood-agar, on which the colonies are translucent and beaded. A poor growth is obtained on ascites-agar; on other media cultures remain undeveloped. Subcutaneous and intraperitoneal injections into rabbits show no evidences of pathogenicity.

BACILLUS 2. Anaërobic bacillus funduliformis (Figs. 5 and 6). These bacilli represent a group allied to Bacillus 1. Extremely pleomorphous, they are most often oval or elongated in shape, with faintly colored bodies and deeply staining ends. Gram's stain is not retained. Nodular, twisted, and globular forms are frequent. A single culture may yield organisms of only one shape, i.e., barrel-shaped bacilli with deeply stained ends, from a subculture of which is obtained an endless variety of forms. Anaërobic conditions are necessary for growth. Best development is obtained on blood-agar and ascites-blood-agar, on which the colonies are large, round, and opaque. On serum-agar, moderate growth occurs. Some strains develop well on alkaline-agar. On other media growth is limited. Gas is seldom produced. Those strains injected into animals were non-virulent.

BACILLUS 3. Anaërobic curved bacillus (Figs. 7 and 8). In a recent description[1] the distinctive features of this organism have been given in detail. Gram-negative, motile, flagellated, crescentically curved, and quite uniform in size, it is easily identified. The bacillus is centrally plump, with tapering or rounded ends, and is from 3 to 5 microns in length. Flagella are present. They are subject to much variation in number, in arrangement, and in point of attachment. In hanging-drop preparations, peculiar rapid, corkscrew motion is observed. Cultures grow only anaërobically. On blood-agar a dustlike coat, composed of minute translucent colonies occurs; on ascites-agar, alkaline-agar and glucose-agar, a slow growth is obtained. Cultures on plain agar, broth, litmus-milk, and potato fail to develop. In cases of profuse leucorrhœa, these bacilli are sometimes in excess of all other bacteria. Following abortion they occur in large numbers. Agglutination tests with the patient's serum were made in one case and proved negative. Pure cultures injected into rabbits are without effect.

BACILLUS 4. A pleomorphous anaërobic bacillus (Fig. 9). A straight or slightly curved bacillus, fairly thick, irregular in outline, and varied in length from 3 to 6 microns. Often single, it also occurs in pairs, sometimes end-to-end, but more commonly placed at an angle. Knobbed and root-shaped forms are frequent. The bacillus stains well but slowly with the usual aniline dyes. Gram's stain is not retained. Best growth is obtained anaërobically. In aërobic cultures there is a very sluggish, poor development, characterized by the appearance of curved, blunted, and knotted forms. On anaërobic blood-agar isolated colonies are translucent and at times plate-shaped, with spreading borders. Thickly growing colonies are similar in appearance to those of non-hæmolyzing streptococci. Organisms from blood-agar condensation fluid are non-motile. A poor growth is obtained on litmus-lactose-agar and on ascites-agar a translucent growth appears. On other media cultures do not develop. This organism is present not infrequently, but is ordinarily difficult to isolate and grow in pure culture.

BACILLUS 5. Anaërobic, short, usually paired bacillus (Fig. 10). This bacillus is one of a group of often-present, similar organisms, of which Bacillus 6 is another example. Organisms identical with or closely allied to these two bacilli are found in almost all cases of leucorrhœa. There is at times some difficulty in distinguishing them from diplococci. Typical forms of Bacillus 5 occur both singly and in pairs. Globular end enlargements, sometimes double and giving rise to ant-like shapes, are frequent. Most stains are taken readily. Gram's stain is retained either very poorly or not at all. Forty-eight hour anaërobic blood-agar cultures contain translucent, round, slightly elevated, non-hæmolyzing colonies. On ascites-agar the growth is similar. A poor development occurs on 0.1 per cent alkaline-agar and growth on 1 per cent acid-agar is rarely obtainable. Only one strain produced an acid reaction in litmus-milk. Broth remains sterile. No gas formation occurs in glucose-agar. The organisms of this group are strict anaërobes.

BACILLUS 6. Anaërobic, small, gram-negative bacilli (Fig. 11), frequently present but repeatedly lost during isolation. Satisfactory sets of cultures were not obtainable. Upon anaërobic blood-agar occurs a delicate, dust-like, translucent growth. Cultures on other media do not develop. Bacilli of this type (see Bacillus 5), small, Gram-negative, mostly paired, two or three microns in length, are frequently found in large numbers in fresh smears and in original mixed cultures. Because of the minuteness of colonies, delicacy of growth, and poorer development when isolated, a differential study of these forms is still incomplete.

BACILLUS 7. Anaërobic bacillus bifidus (Fig. 12). Peculiar branched forms characterize this bacillus. "Y" and angular types are frequent. Deeply staining nodular end enlargements are common. There is a considerable variation both in length and in breadth. The smaller organisms stain lightly, are thin and often slightly curved. Growth does not occur aërobically. On ascites-agar there is an excellent translucent granular development. On

[1] J. Infect. Dis., 1913. xii, 165.

blood-agar similar growth occurs. Nodular forms are frequent on slightly acid-agar and still more numerous on alkaline-agar. Acid is not produced. Gas formation does not occur in glucose-containing media. Bacillus bifidus has been found very few times in this series.

BACILLUS 8. Pseudodiphtheria bacilli (Fig. 13). Especially the large beaded types of pseudodiphtheria bacilli are found. Evidence indicates that when these bacilli are present in the upper part of the vagina it is chiefly in patients who douche frequently, or who have extreme grades of laceration or relaxation of the vulvar region. Their usual habitat is in the region of the vulva. When forced up through mechanical means or when relaxation favors entrance, they are to be found in high vaginal cultures. The relationship of these bacilli to leucorrhœa requires further study.

BACILLUS 9. Bacillus coli. Bacilli of the colon group are present less commonly than is popularly supposed. About the vulva they are frequent. In the upper vagina they are numerous in those patients who make free use of douches. The type most frequently isolated acidifies but does not coagulate milk. In morphology, motility in hanging-drop, and reaction on various media, there are no other noteworthy variations.

OTHER BACILLI. Bacilli of the mycoides and subtilis groups are isolated from patients who have persistently and frequently made use of douches. In smears they are most commonly present in only small numbers, and in plate cultures show but few colonies. Yet in some instances plate cultures are predominated by their rapid growth. Those whose hygienic surroundings are such that sterilization of douche solutions and general opportunities for cleanliness are unsatisfactory are the chief ones who harbor these germs.

Bacillus proteus, a black-pigment-producing organism (found elsewhere), influenza-like bacilli, a small aërobic bacillus, and some other unclassified forms have been encountered also.

COCCUS 1. Anaërobic streptococcus (Fig. 14). In fresh vaginal smears these cocci are practically always in the form of diplococci. On artificial media they form very long chains composed of oval or lancet-shaped cocci in diplo-arrangement. The cocci of different strains are subject to much variation in length and may assume extremely long bacillus-like shapes. Good stains are obtained with the usual aniline dyes. Gram's stain is retained.

Growth occurs only in anaërobic cultures. Best results are obtained on blood-agar media, on which the growth is characteristic of streptococci in general. Hæmolysis does not occur. When cultures are opened, a disagreeable but not particularly foul odor is noted. A fair growth is obtained on ascites-agar. Some strains show a poor development on alkaline-agar and on slightly acid-agar. On glucose-agar growth is poor or wanting. Gas is rarely produced. Litmus milk is not acidified. Broth cultures remain clear and without precipitate. Cultures on blood-agar which was made from a patient's blood showed good growth, but microscopically were found diplococci or cocci only in short chains, whereas control blood-agar cultures contained chains of enormous length. Opsonic and agglutination tests give no indication of immunity. A study of the relationship of anaërobic to aërobic streptococci through determination of the point of opsonic extinction reveals that standard antistreptococcic serum evidently has very little, if any, power of sensitizing anaërobic streptococci.

To ascertain the virulence of various strains, several guinea pigs and rabbits were injected, both subcutaneously and intravenously, with large doses of organisms. There was no evidence in any case of more than temporary distress.

COCCUS 2. Anaërobic staphylococcus (Fig. 15). This minute coccus may be either in small clumps or isolated. It has been obtained only twice in pure culture. Several strains thought to be anaërobic staphylococci have finally grown aërobically. On blood-agar, a poor growth develops. Gram's stain is not retained.

COCCUS 3. Hæmolyzing aërobic streptococcus. In smears of fresh material, these cocci, like the anaërobic streptococci, exist most often as diplococci. In aërobic cultures the organism promptly grows out into long chains. The proportionate number of hæmolyzing streptococci in the vagina is seldom great, but their ease of cultivation often yields a surprising number of colonies on artificial media. The chief features of growth agree closely with those common to streptococcus pyogenes. The scattered arrangement and small proportionate number of these cocci in smears of fresh material lend weight to the belief that they play an insignificant rôle in the production of leucorrhœa.

COCCUS 4. Non-hæmolyzing aërobic streptococcus. Non-hæmolyzing vaginal streptococci, like the other varieties of streptococci, when observed in fresh discharges are rarely found in chains. On artificial media they form chains, the individuals of which commonly have a diplo-arrangement. Some strains consist of very large cocci, 2 microns or more in length and 1½ microns in breadth. The larger types are often in pairs, fours, or short chains, intermingled with which are chains of greater length.

COCCUS 5. Aërobic staphylococcus. Contrary to the general impression, aërobic staphylococci are not numerous in the upper vagina in unmanipulated cases of leucorrhœa. As they are common in the vulvar region, the oft-repeated and careless use of douches greatly increases their frequency. A few colonies are often present, but they are rarely in numbers which signify that the rôle played by them is more than a minor one.

COCCUS 6. Gonococcus. In smears of leucorrhœal pus the gonococcus resists positive identification. It can be differentiated from other forms only if found in considerable numbers and in typical arrangement. From its favorite locations it is,

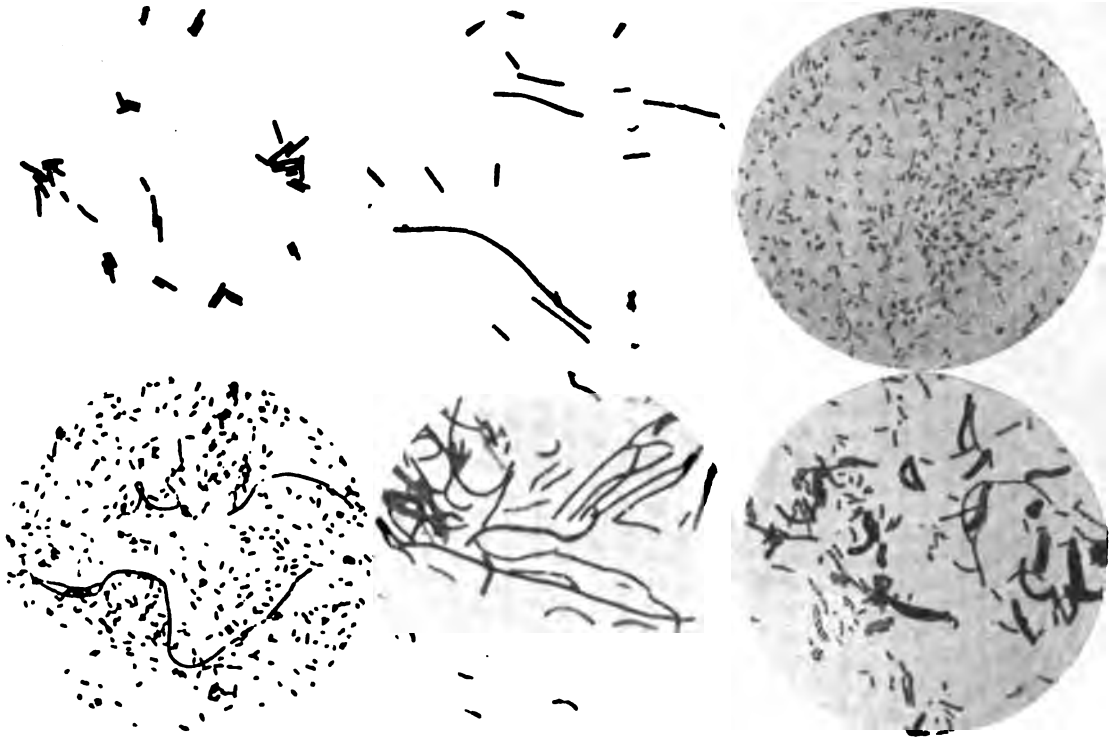


Fig. 1. Fig. 2. Fig. 3.
Fig. 4. Fig. 5. Fig. 6.

Fig. 1. Typical smear from uncontaminated vagina containing pure growth of Döderlein bacilli. Gram stain. x 1200. Fig. 2. Smear from an uncontaminated vagina showing variation in size of Döderlein bacilli. x 1200. Fig. 3. Bacillus 2. Showing pleomorphism of bacillus funduliformis in pure culture. Carbo-gentian-violet. x 1200. Fig. 4. Bacillus 1. Pure culture anaërobic cocco bacillus. Transition from coccus to long bacillus forms is well shown. Carbo-gentian-violet. x 1200. Fig. 5. Bacillus 2. Anaërobic bacillus funduliformis in pure culture. Carbo-gentian-violet. x 1200. Fig. 6. Bacillus 2. Showing pleomorphism of bacillus funduliformis in pure culture. Most often oval or elongated in shape. Carbo-gentian-violet. x 1200.

however, obtained frequently enough to reveal its enormous importance as the primary cause of subsequently developing leucorrhœa.

It is planned to consider thoroughly the gonococcus-like flora of the lower genital tract. The classification of Bumm,[1] which is probably the best available, leaves a gap in our knowledge of how to satisfactorily differentiate gram-negative diplococci.

## IV. DISCUSSION

Certain conditions predispose to leucorrhœal discharges. Important among these are lacerations and displacements, changes in the cervix which cause increased mucous secretion, infections complicating pregnancy, and gonorrhœa.

Although we are mindful of these predisposing factors, our interest centers at present in the various bacteria. *Especially do we wish to know whether bacteria are the cause of leucorrhœa or merely play an unimportant and non-essential rôle.*

Fresh preparations from the uncontaminated vaginal canal show almost exclusively Döderlein's large, gram-positive vaginal bacilli. Many clinically normal cases, e.g., healthy married women, also reveal chiefly bacilli of this type.

The more patients deviate from the absolute normal, with only Döderlein bacilli, i.e., the greater the tendency to discharge formation and the more purulent its nature, the more nearly do the bacteriologic findings resemble in character the picture presented by pathological cases.

[1] Bumm. "Der Mikro-organismus d. gonorrh. Schleimhauterkrankungen." Wiesbaden, Monograph, 1885.

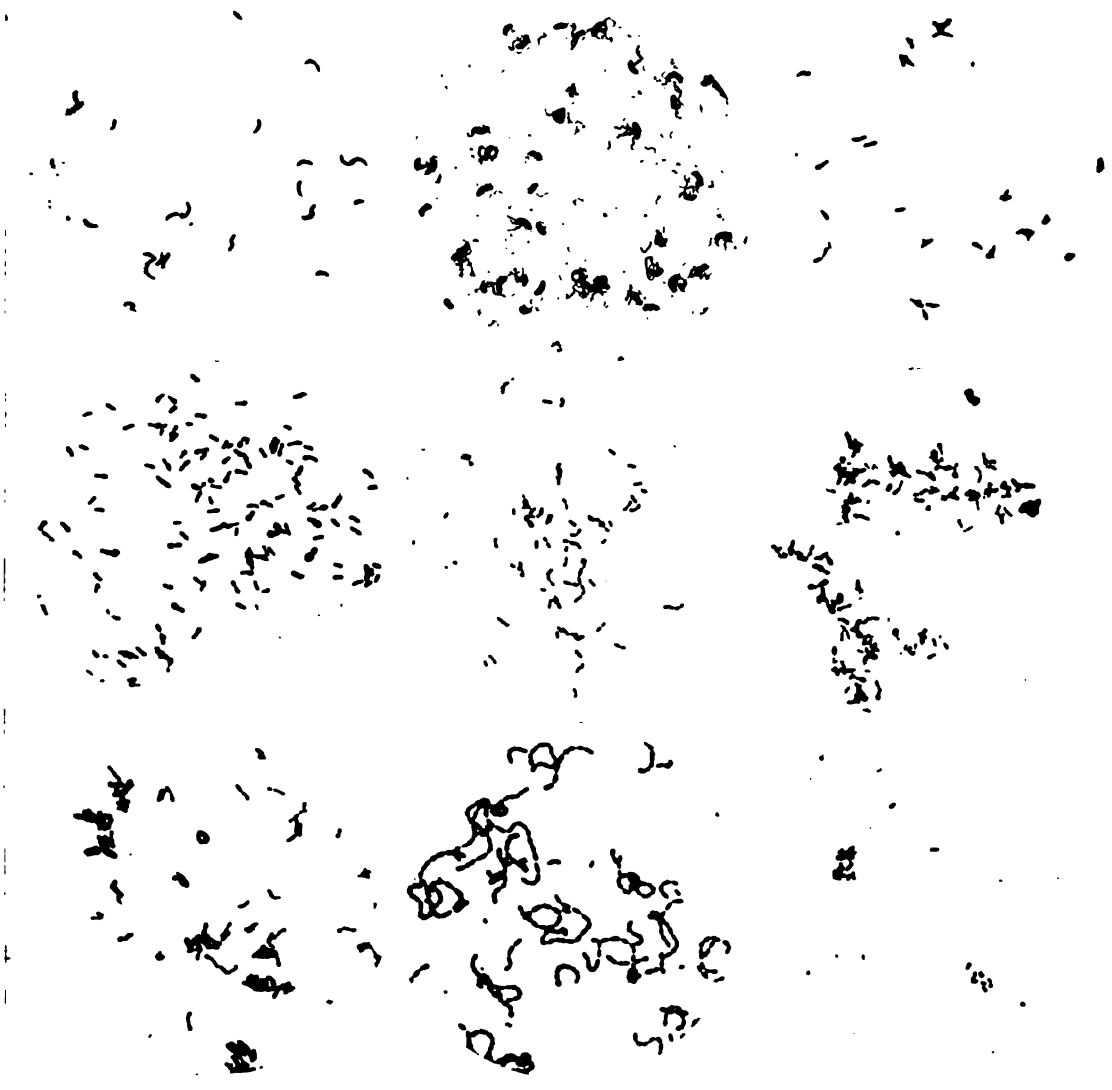


Fig. 7. Fig. 8. Fig. 9.
Fig. 10. Fig. 11. Fig. 12.
Fig. 13. Fig. 14. Fig. 15.

Fig. 7. Bacillus 3. Motile curved anaërobic bacillus. Carbo-gentian-violet. x 1200. Fig. 8. Bacillus 3 (same as preceding). Stained by Zettnow's silver nitrate method to show flagella. x 1000. Fig. 9. Bacillus 4. Anaërobic knobbed and root-shaped forms are prominent here. Carbo-gentian-violet. x 1200. Fig. 10. Bacillus 5. Anaërobic, usually paired. This is one of a group of very similar organisms. Carbo-gentian-violet. x 1200. Fig. 11. Bacillus 6. Anaërobic, small, gram-negative, frequently present but repeatedly lost during isolation. Fig. 12. Bacillus 7. Anaërobic bacillus bifidus. Pure culture. "y" and angular forms are characteristic. Carbo-gentian-violet. x 1200. Fig. 13. Bacillus 8. Pseudodiphtheria bacilli of type common in vulvar region. Gram. x 1200. Fig. 14. Coccus 2. Anaërobic streptococcus. Note diplo-arrangement and large forms. x 1200. Fig. 15. Coccus 2. Anaërobic staphylococcus. Carbo-gentian-violet. x 1200.

Characteristic of smears and cultures from leucorrhœal discharges is the preponderance of anaërobic organisms. Certain types of anaërobic bacilli are predominant. In the cases studied, types represented by Bacilli 6, 5, 2, 1 and 3 have been most frequent. Gram-positive diplococci are always present. Often they are in considerable numbers, but not in groups or chains, and never in excess of bacilli. These facts bespeak a somewhat passive part in leucorrhœa production. *Streptococci are almost never found in fresh preparations, but develop from diplococci on artificial media.* This fact has heretofore apparently been overlooked. Diplococci develop in culture into long-chained, anaërobic streptococci in probably 30 per cent of the cases. Aërobic streptococci are similarly frequent in culture.

Evidence indicates that the anaërobic flora, notably its bacilli, is of paramount importance. An increase in the relative number of aërobes is roughly proportional to the amount of contamination through douches and other external influences. Staphylococci are often found, but they are notable chiefly for their small number. If we exclude those cases in which inflammation is acute, it is doubtful whether bacilli of the colon group actively participate in the production of leucorrhœa.

The rôle of the gonococcus deserves careful consideration. Gonorrhœal infection is the exciting cause of leucorrhœa in the vast majority of women who have never been pregnant. After creating conditions favorable for the development of other organisms, which are accompanied by profuse purulent discharge in an astonishingly large percentage of cases, the gonococcus so completely disappears that it is not demonstrable through any means at our command. This suggests that a chief part played by the gonococcus in chronic leucorrhœa consists in preparing the soil for the leucorrhœa-producing anaërobic organisms.

A final factor of importance in determining the rôle of bacteria in leucorrhœa is shown by the results of treatment. Through bacterial or vaccine therapy alone, as will be reported later, some cases with constant chronic discharge have been markedly affected, both systemically and locally.

These views of leucorrhœa may be summarized as follows:

1. The uterine cavity tends to remain free from bacteria in cases of leucorrhœal infection, but mucous secretion from the cervix may promote the development of purulent discharges.

2. The usual seat of formation of purulent discharges is the lower genital tract.

3. In unmarried women gonorrhœal infection precedes the development of chronic leucorrhœa in the majority of instances. A chief part played by the gonococcus consists in preparing the soil for other organisms.

4. The great contingent of leucorrhœal bacteria consists of anaërobes, of which gram-negative bacilli form a large proportion. It is highly probably that these bacteria play an active part in the production and maintenance of leucorrhœa. Common aërobic organisms, such as B. coli and staphylococci, seem to be of minor importance.

For material furnished and keen interest manifested in this work, I am indebted to Dr. Thomas J. Watkins.

# ABSCESS OF THE TESTICLE[1]

By J. DELLINGER BARNEY, M. D., Boston
Genito-Urinary Surgeon to Out-Patients, Massachusetts General Hospital; Assistant in Genito-Urinary Surgery, Harvard Medical School

As an occasional complication in various diseases, such as typhoid fever, glanders, syphilis, tonsillitis, smallpox and mumps, or as a sequel to some septic process elsewhere in the body, acute orchitis, with or without abscess formation, has been recognized from early times. But as a primary disease, without a demonstrable focus from which it might arise, abscess of the testicle is of great rarity. It is this type of orchitis which we propose to discuss. We wish further to make it clear that we are dealing here only with abscess of the testicle, and not of the epididymis.

Although, so far as we are aware, the records of the Massachusetts General Hospital contain no undoubted example of this type of orchitis except the one to be reported, the writer has been fortunate enough to see two others in his own practice. Also, in a somewhat scanty literature on the subject, we have met with only two or three similar cases.

Case 1. A. P., 62 years old, married, builder. Admitted to the genito-urinary service at the Massachusetts General Hospital on December 8, 1912.

Family history and past history negative except as given below. Alcohol to excess as a young man. None for many years. Strenuously denies venereal disease.

When a boy he had a swelling of the left side of the scrotum, not very painful or tender, and of a few days' duration. Another similar attack fifteen months ago, lasting two or three days. No known cause. These attacks were not associated with urethral discharge or urinary symptoms.

October 12, 1912, the patient caught a severe cold. He developed much frequency of urination—every two or three hours by day, every hour by night. Considerable dysuria and tenesmus, but no difficulty of urination or retention. Says the urine was cloudy. After straining at the end of micturition, patient noticed a discharge from the meatus. None between times. Urinary symptoms subsided in about two weeks.

Coincident with the disappearance of the urinary symptoms, which was about three weeks ago, patient noted a swelling of the left scrotum, and this has steadily increased in size and tenderness. Very little pain till recently. Now the pain is heavy, dull, and dragging. Frequency of urination is five or six times by day, three or four times by night. Weight two months ago, 212 pounds; now 195 pounds. No headache or vomiting.

Other than the condition of the left scrotum, physical examination, including prostate and vesicles, showed absolutely nothing abnormal, the only points worth noting being the presence of an extensive pyorrhœa alveolaris and a considerable redness of the throat. The temperature at time of entrance was 98.8° F. Systolic blood pressure was 165 mm. of mercury. The Wassermann reaction and the gonococcus fixation-test were negative. The urine was clear and sparkling, contained no shreds or albumin, and was sterile to culture. Guinea pigs inoculated with it were reported later as negative for tuberculosis.

The penis and right side of the scrotum were normal. The left scrotum presented as a large, rounded tumor, about four inches in diameter, the swelling extending well up into the inguinal canal. Except on the anterior surface the skin was much thickened and brawny. Anteriorly, the tumor was fluctuant, with red, shiny, adherent skin. The tumor was smooth, elastic, moderately tender. Testis and epididymis could not be distinguished. The whole spermatic cord was much thickened, the vas itself not being identified. Dr. Hugh Cabot, who saw the case with me, made a diagnosis of epididymitis with abscess formation.

Immediate operation was advised and performed by the writer. The fluctuant area of the tumor was incised, with the escape of about four ounces of thick, yellow, odorless pus, mixed with necrotic tissue. This pus showed in pure culture the bacillus mucosus capsulatus and the streptococcus. Exploration with the finger showed that this pus came, not from the tunica vaginalis, which had not been opened, but from the surrounding tissues, which were sloughing and necrotic. The greatly thickened tunica was then opened, with the escape of two or three ounces of thick, yellow pus, mixed with necrotic tissue in which were seminiferous tubules. This pus contained the bacillus mucosus capsulatus in pure culture. Attempts to separate tunica from testis revealed dense adhesions between them. The testicle now presented in the incision and was found to contain an abscess cavity the size of an English walnut, from which still more pus and necrotic testicular tissue could be expressed. The epididymis was not seen, but was felt posteriorly, thickened and indurated. The whole spermatic cord was much thickened. This was tied off in sections and divided near the external inguinal ring,

[1] Read before the American Association of Genito-Urinary Surgeons, Washington, D. C., May 6 and 7, 1913.

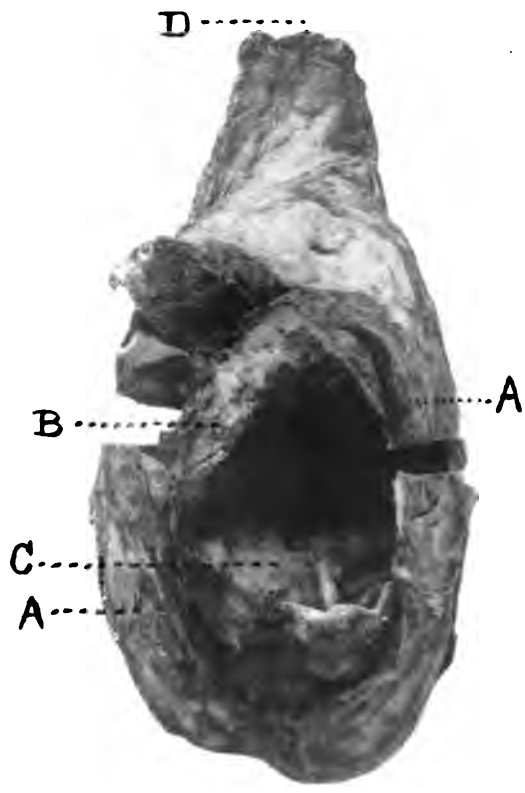



Fig. 1. Anterior view.

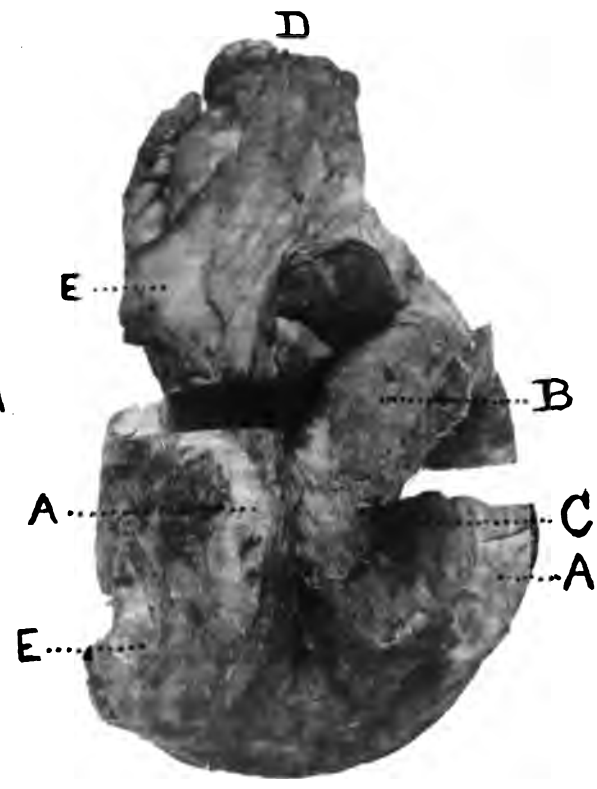



Fig. 2. Lateral view.

Section through the wall of an abscess of the testicle. A, thickened tunica; B, remains of wall of testicle; C, abscess cavity in testicle; D, spermatic cord; E, epididymis. Photographs by L. S. Brown.

thus removing *en masse* the testicle, epididymis, and tunica vaginalis (Figs. 1 and 2). In the cut-section the vas appeared to be normal. The inner aspect of the scrotal wall, very necrotic, was then thoroughly curetted, and the cavity swabbed with tincture of iodine.

Convalescence was uneventful, and the patient left the hospital ten days later.

He came to the out-patient department several times a week for dressings. The wound was entirely healed January 17, 1913. On January 24th he returned with a profuse urethral discharge of about 24 hours' duration. There had been no coitus since October. Urination was four or five times day and night, and there was considerable dysuria. The urine was cloudy throughout and contained a few shreds. Smears of the urethral discharge showed much pus and many large gram-positive intracellular cocci. No gram-negative organisms were seen. A culture of this pus showed a profuse growth of gram-positive bacilli and cocci. No gonococci were found. Four days later the urethral discharge and the symptoms had subsided and the urine was perfectly clear and sparkling. It is possible that the organisms found in the abscess and in the subsequent urethral discharge were identical, but unfortunately no steps were taken to compare them.

Sections of the testicle at the points shown in the photographs (Figs. 1 and 2) were examined by Dr. S. B. Wolbach, assistant professor of bacteriology at the Harvard Medical School. We wish here to express our gratitude for his courtesy. His report is as follows:

"Section through the wall of an abscess of the testicle including testicular tissue and tunica albuginea (Fig. 3). The border

lining the abscess cavity in the testicle contains a few small masses of necrotic material, and in a few places, springing from the interstitial tissue, are small areas of granulation tissue. The tubules in the abscess wall are flattened and distorted. The germinal epithelium shows various stages of atrophy to complete disappearance. The cells of the tubules are represented by thick convoluted bands of hyaline fibrous tissue. The interstitial tissue throughout the wall of the abscess shows connective-tissue increase and the formation of new capillaries. The tubules contain an occasional migrating polymorphonuclear leucocyte. The fibrosed interstitial tissue is everywhere infiltrated with polymorphonuclear leucocytes, lymphoid and plasma cells. The external border of the tunica is very much injected; in places there are small hæmorrhages. It is infiltrated with polymorphonuclear leucocytes, lymphoid and plasma cells. At one end of the section, involving the tunica and the testicular tissue, is an abscess cavity lined with granulation tissue and necrotic material. The necrosis has extended irregularly into the substance of the testicle, following the interstitial tissue. This abscess cavity is apparently at the reflection of the tunica vaginalis upon the testicle. There are smaller abscess cavities in the greatly thickened and fibrosed tunica vaginalis.

"There is nothing distinctive in the pathological process represented by this section. The changes are such as might be found in the tissues surrounding an abscess due to any of the pyogenic organisms. The process has been extending by way of the interstitial tissue. The changes in the tubules are largely due to pressure and subsequent atrophy, except where they are totally necrotic through involvement in the abscess cavity."

The two following cases were seen by the writer in his own practice.

CASE 2. H. K. H., 30 years old, single. Referred by Dr. A. J. Halpin of Lowell, Massachusetts, February 13, 1912, for chronic prostatitis.

The patient had had gonorrhœa about a year previously. Six months later the left epididymis became involved. Since this he had had prostatic massage, irrigations, and sounds regularly every week. The urine was clear, with a few shreds; there was no urethral discharge, but there was a little pus in the prostatic secretion. The left epididymis was slightly thickened. After one or two visits the patient disappeared. Two weeks later I was called to see him. On the day after his last visit the left side of the scrotum became tender, painful, and swollen. The condition rapidly grew much worse. There was marked constitutional disturbance, evidently much fever, and great pain. There had been no urethral discharge or urinary symptoms.

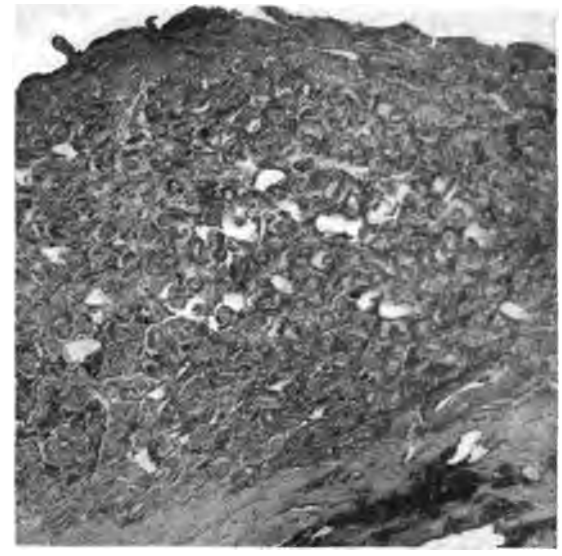


Fig. 3. Microphotograph (13 diameters) of section of abscess wall. Upper edge of section shows abscess wall; lower edge shows tunica. Photograph by L. S. Brown.

When seen by me the patient looked very sick and had evidently lost much weight. The left side of the scrotum was much enlarged, red, indurated, and brawny. Anteriorly the tumor was fluctuant. The vas was moderately thickened. Nothing abnormal was made out in the right side of the scrotum or in the prostate or vesicles. No discharge could be milked from the urethra. Urine was not seen.

The fluctuant area was incised, with the escape of about one ounce of thick yellow pus, containing the colon bacillus in pure culture. Testicular tissue, necrotic and sloughing, appeared in the wound. There were many strong adhesions between the layers of the tunica vaginalis. On separating these the epididymis was found to be essentially normal in size and consistency. The whole lower half of the testicle was involved in an abscess, leaving a cavity around which was a dense, tough, yellowish wall. The upper half of the testis appeared to be normal in size and consistency, and, together with the epididymis, was left behind in the hope of saving it. The necrotic tissues were carefully curetted and the wound drained.

Fig. 4. Type 1. 1, spermatic artery; 2, epididymal branch of the spermatic; 3, deferential artery; 4, funicular artery; 5, epididymo-funiculo-deferential anastomosis in form of T. Photographs of Figs. 4, 5 and 6 by L. S. Brown after Picqué and Worms.

Fig. 5. Type 2. 1, spermatic artery (main trunk); 2, internal spermatic artery; 3, external spermatic artery; 4, epididymal branch; 5, deferential artery; 6, funicular artery; 7, spermato-funiculo-deferential anastomosis in form of T.

Fig. 6. Type 3. 1, spermatic artery; 2, epididymal branch of spermatic; 3, deferential artery; 4, funicular artery; 5, anastomosis between epididymal branch and deferential artery; 6, anastomosis between a testicular branch of spermatic and funicular artery.

Convalescence was uneventful, except that during it the upper half of the testicle sloughed out, leaving behind an epididymis which, up to date, seems perfectly normal.

CASE 3. G. B., 35 years old, single, lawyer. Referred to the writer on December 31, 1910, by Dr. John W. Dewis of Boston.

Gonorrhœa several times, with bilateral epididymitis four years previously. About four weeks ago the right side of the scrotum became swollen and painful. Patient was confined to his bed for several days on account of pain and tenderness. A few days ago an abscess formed in the front of the scrotum, causing much pain. There has been no discharge from the urethra and no abnormality of micturition.

The patient looked sick and haggard. The right side of the scrotum was found to be much enlarged, very œdematous, indurated, and reddened. In front, near the raphé, there was a soft, fluctuant area. The scrotal contents could not be made out. The left testis and epididymis were normal.

Orchidectomy was performed by the writer. The whole spermatic cord was much thickened and matted together, but the vas itself was not enlarged. Incision of the fluctuant area in the scrotum allowed the escape of much thick pus, mixed with necrotic testicular tissue. The tunica was much thickened and adherent to the testicle anteriorly. The latter was involved in an abscess which invaded chiefly its upper half. The epididymis did not seem to be inflamed. Unfortunately, no cultures were taken.

That the testicle, even in the presence of an actively suppurating epididymis, is extremely resistant to bacterial invasion we are all aware. Its power to recover from severe infection, as, for example, tuberculosis, after removal of the primary focus in the epididymis has been shown by the writer in his studies of epididymal tuberculosis. It would seem, therefore, that Nature had planned well to preserve to the last an organ which is of prime importance, not only for her welfare but also for that of its owner.

The defense of this vital organ is twofold, consisting on the one hand of its dense and intimately applied tunica albuginea, on the other of its rich and elaborate blood supply; and finally, we must regard the rich lymphatic network with which it is surrrounded and permeated (Testut and others) as being a protective factor of no little value. Also we regard it as possible that the little under-

stood but none the less recognized internal secretion of the testicle may contribute more or less to its comparative immunity. The value of the albuginea as a protective shield was recognized and described years ago by Gendrin, whose opinion was also shared by Curling. The latter says:

"When the contiguous organ or adjacent part is of a different structure from that of the cellular tissue, the extension of the inflammation inward is checked. Thus in the case of the inflamed tunica vaginalis the cellular tissue readily transmits the morbid action to the epididymis, but the tunica albuginea arrests its progress to the body of the testicle."

The elaborate blood supply already mentioned is to be regarded as a two-edged sword. Not only can it maintain such a high state of nutrition in the testicle that incoming bacteria are readily discouraged, but obviously it also serves as the high road along which these organisms can travel. This rich vascularity of the organ, a kindly provision of Nature not only for the salvation of the reckless surgeon, but also for the testicle itself, has been demonstrated by Picqué and Worms, who have perfected and confirmed the work of many earlier investigators in a large series of careful dissections of injected human specimens. They have shown constant but slightly variable anastomoses between the spermatic, the deferential, and the funicular arteries (the latter running in the walls of the tunica vaginalis). These variations fall roughly into three groups (Figs. 4, 5 and 6). In each, however, it is clear that blood is conveyed to the testicle by the three different arteries already mentioned, any one or two of which may be, and often are, destroyed without harm to the organ.

If now we are to regard the rich blood supply of the testicle not only as a means of defense but also as the conveyer of infectious organisms, we may well ask, Why is not the one function of the blood stream nullified by the other? The question is partially answered by the statement of Belfield that the testicle, like the kidney, is an excretory organ. He has recently said:

"While the kidney is provided with a new and private sewer, the ureter, the testis continues to use the frog's old urinary duct, now called epididymis and vas deferens. This excretory function of the testicle and its duct illumines both its intimate alliance with the kidney and its frequent infection from the blood. . . . The recognition of the testicle as an excretory organ illumines the frequent invasion of its tubules by mumps, typhoid and colon bacilli, spirochæta pallida, and other blood infection."

For our purposes we must go farther, and attribute to the testicle not only an excretory but also a selective function. In this way only can we explain its freedom from invasion by the gonococcus and, to a certain extent, the tubercle bacillus. For these two organisms at least, and especially the first, the testicular soil is inimical. On the other hand the testes seem, on occasion, to offer favorable conditions for the growth of the organisms of typhoid fever, mumps, glanders, and syphilis. These organisms rarely if ever attack the epididymis, and then only late in the disease. Here again is evidence of a selective function.

The pyogenic organisms such as the colon bacillus, the bacillus mucosus capsulatus, and the staphylococcus aureus find conditions favorable for their growth in testis as well as in epididymis. In this group we can also place the tubercle bacillus, for, as we are all aware, while it attacks the epididymis primarily, it may later invade the testicle, flourish there in a half-hearted manner, and disappear after the removal of the primary focus.

It is our conviction that organisms of various types may and do circulate in the blood stream at various times and under certain conditions. To the fact that they find lodgment in certain organs and tissues when circumstances are favorable is due the occupancy of most of the beds in our hospitals.

It is clear that these organisms find their way into the testis and epididymis as freely and as frequently as into other organs, perhaps more so, owing to the fact that their main blood supply, the spermatic arteries,

take origin from the aorta, which might reasonably be called the distributing center. But we have seen (Figs. 4, 5, and 6) that the circulation of the testicle and epididymis is not only very rich, but also is so arranged that organisms passing through any one of the three main arteries have free access to both organs, more especially the testicle. This being the case, we must look to the selective action of each organ, already discussed, to explain the invasion of testicle by one organism, of epididymis by another, and of either or both organs by a third. Furthermore, we must ascribe infection of the epididymis, more frequent by far than that of the testicle, to a less active resistance, this being due perhaps to the difference in the blood supply of the two organs which we have seen exists, and also to the comparative poverty of the epididymis in its lymphatic circulation.

What evidence have we that the infection of the testicle in the three cases reported occurred, not by way of the vas deferens, not through the lymphatics, but by way of the blood stream?

In the first place Esmonet, in 1902, showed that the testicle could be infected much more easily and frequently by injection of organisms (tubercle bacilli) into the general circulation through the aorta than through the vas deferens, even though a condition of stasis was produced by ligature of that structure. The more recent work of Walker has confirmed this view. Speaking of his experimental production of tuberculosis of the testicle in guinea pigs, he says:

"In those cases in which the animals had received injections into the aorta and were killed within a short time afterward I found in one gland several small capillaries containing tubercle bacilli, and in another I observed very young tubercles close to the blood-vessels. It is presumable from this that the organisms penetrate the walls and form a tubercle in the immediately surrounding tissues."

What applies to the tubercle bacillus may apply as well to other organisms. But it must not be forgotten that in clinical material, owing to the length of time which generally elapses from onset of disease to time of operation, the pathologist is obliged to read the story backward, a feat which he is either unwilling or unable to perform.

Secondly, it is now universally acknowledged that renal tuberculosis occurs, not by ascending infection through the ureter from the bladder, but by a hæmatogenous or lymphatic route. In other words, infectious processes tend to follow the natural route of the secretions or excretions of the organs involved. Thus it is also acknowledged by most that in genital tuberculosis the epididymis is primarily attacked, prostatic involvement being secondary. Thus the tubercle bacillus follows the current in the vas deferens from epididymis to prostate. Even in the frequent examples of involvement of the second epididymis shortly after the involvement of the first side there is ample experimental and clinical evidence to show that this too is not a deferential, but a hæmatogenous or, in certain cases, a lymphatic transmission of bacilli.

Thirdly, in many infections of the testicle by the typhoid bacillus, as well as by other organisms, repeated examination of the urine microscopically and bacteriologically has revealed no bacteria. The infection is clearly hæmatogenous, although in a few cases note has been made of the involvement of the whole spermatic cord or of the vas, indicating possibly a migration of organisms through the lymphatics.

And so it must be regarded in our first case, if not in the others as well. All the diagnostic means at our disposal failed to reveal a focus of infection in the body, not even in the genital or urinary tract, although it seems probable that the patient had had an epididymitis and possibly a prostatitis, perhaps of gonorrhœal origin. The patient had a severe pyorrhœa alveolaris and a reddened pharynx. Possibly a culture from these two points would have thrown light on the matter. The infection of the testicle in the second case with the colon bacillus is equally obscure and purely a matter of speculation. But in both it seems clear that the infection was hæmatogenous, although we cannot exclude a lymphatic origin.

This view is strengthened in the first case at least by the report of the pathologist, who finds the process to have extended by way of the interstitial tissue, a fact which suggests a blood-borne infection. The work of Walker seems to bear out this belief.

Reduced to its lowest terms, this discussion summarizes as follows:

1. The testicle is protected from infection by its tunica albuginea on the one hand and by its rich blood and lymph supply on the other.

2. Arguing from an embryologic viewpoint, the testicle, like the kidney, may be regarded as an excretory organ.

3. As blood-borne organisms reach epididymis and testicle with equal freedom and frequency, it would appear that the latter has a selective function, rejecting certain organisms and harboring others.

4. Most of the testicular infections are hæmatogenous. A few probably are lymphatic in origin.

5. Infection of the testicle resulting in abscess and without epididymal involvement is exceedingly rare.

## BIBLIOGRAPHY

BARNEY. Boston M. & S. J., 1911, Dec. 14; 1912, Mar. 14; 1913, June 19.
BELFIELD. J. Am. M. Ass., 1912, Oct. 19.
CURLING. "Diseases of the Testis," 3rd ed.
ESMONET. Thèse de Paris, 1903.
GENDRIN. Quoted by Curling.
PICQUÉ and WORMS. J. de l'anat. et de la phys. nor. et path., 1909, i, 51.
TESTUT. Traité d'Anatomie Humaine, Paris, 1897.
WALKER. Johns Hopkins Hosp. Rep., xvi.

# ELEPHANTIASIS CONGENITALIS LYMPHANGIECTATICA

## WITH THE REPORT OF CASE FROM THE SERVICE OF DR. BESLEY AND A PATHOLOGICAL REPORT BY HARRY JACKSON, M. D., OF THE NORTHWESTERN UNIVERSITY MEDICAL SCHOOL, DEPARTMENT OF PATHOLOGY

BY FREDERIC A. BESLEY, M. D., CHICAGO
Associate Professor of Surgery, Northwestern University Medical School; Attending Surgeon, Cook County Hospital; Attending Surgeon, Wesley Hospital

ALTHOUGH in the title of this article I follow the classification of Kaufman, it is not my intention to insist upon any essential difference between this condition, which I have named as a variety of elephantiasis, and the lymphangiomata. If anything, its frequent situation upon the entire lower extremity, its lobulation, with cutaneous thickenings and subcutaneous fibrosis, and the general pathological character indicative of vascular stasis and dilatation, with subsequent fibrosis rather than of new growth, are the considerations in favor of this nomenclature. Nevertheless, the distinction between the congenital types of elephantiasis and lymphangiomata (which are usually congenital neoplasms) is little more than one of terminology. Hereafter they will be spoken of rather indiscriminately. Both present the same hyperplastic elements, not only the lymphatic vessels, but also the fatty and fibrous tissues, and the smooth musculature of the walls of the larger lymphatics participating in these growths (Ribbert). A variable amount of lymphatic fluid, often very abundant, occupies the dilated and tortuous lymph channels, and in addition there may be considerable tissue œdema.

The congenital origin bespeaks a disturbance in embryonic development. Thus these conditions may often be associated with other anomalies, such as myeloceles, encephaloceles.

Their size may be complete at birth, as in our case given in illustration, small tumefactions may undergo unlimited subsequent enlargement, or neoplasms may develop late from congenital beginnings.

Lymphangiomas may be simple, cavernous or cystic, but most forms actually encountered are mixed or transitional in character.

Simple lymphangiomas are proliferations of lymphatic vessels and connective tissues, occurring usually upon the face and neck as congenital, flat or somewhat nodular thickenings of the skin and subcutaneous tissues, which are but slightly circumscribed. They are related to pigmented nævi, lentigines, freckles, and flesh warts; but these, because of their excessive hyperplasia of endothelial cells, are better classified with the endotheliomata (Ziegler).

Cystic lymphangiomata present uni- or multilocular cysts, minute in size to that of a child's head. These are lined with endothelium and filled with serous fluid. Sites of predilection are the neck, posterior to the sterno-cleido-mastoid, about the angle of the jaw and in the supraclavicular fossa; less frequently, the cheeks, axilla, groin, extremities, the anterior surface of the sacrum and in the root of the mesentery. They are definitely encapsulated and thus the most favorable type for surgical measures.

It is, however, the cavernous lymphangiomas, or those forms chiefly cavernous, that principally concern us here, as they are practically identical with congenital, lymphangiectatic elephantiasis. We give in illustration a case report of an instance of the latter. A study of the microphotographs illustrative of this case gives a good example of the dilated lymph spaces, which are characteristic of this type of angioma.

Lymphangioma cavernosum is the most frequent form of the diffuse, non-encapsulated lymphangiomas. They appear in the cheeks (macromelia), the lips (macrocheilia), the tongue (macroglossia), the concha, eyelids and mucous membrane of lips and palate — also as lobulated growths of considerable size upon the face, the neck, and the lower extremity (as in our case), and it is to these forms that the term "elephantiasis congenitalis lymphangiectatica" has been applied.

Fig. 1.

Fig. 2.

Fig. 3.

Possibly their appearance and location (when on the leg) have been suggestive of this name. It would be of no practical value to enter into theories of etiology, such as intrauterine pressure and subsequent stasis being causal rather than neoplastic formation; and as before stated, the pathological differences are not inessentials.

The example given presented mainly the picture of cavernous lymphangioma, and if portions vary, it is to be remembered that most of these are mixed in form.

These tumefactions occur in the skin, subcutaneous, and sometimes in the intermuscular tissues. Their appearance, as indicated above, is variable, from the flat, smooth, loose swellings in the cheek to the lobulated forms. Their boundaries are ill-defined. The lymph spaces communicate with the legitimate lymphatic channels, so that prolonged pressure reduces the size of the tumor, and the same is gradually regained later upon its cessation. The overlying skin is little, if at all, discolored, and cannot be raised from the tumor. Pachydermia is more common in the lobulated forms; consistency is soft, with an indistinct sense of fluctuation.

Slow growth is usual. Rapid increase and decrease in size is common in all forms of lymphangiomas, sometimes due to the occurrence of infection. Acute inflammation may result in subsequent cicatrization and shrinkage, but may lead to dangerous complications, such as extension along lymphatics or sloughing and exhausting lymph fistulæ. Regular growth is, however, the rule; skin and muscles may be infiltrated, nerves and blood vessels pushed aside, and even bone eroded.

Treatment is most satisfactory in the cystic forms which are encapsulated, and may be completely enucleated by blunt dissection, removing as much skin as may be required. Complete removal is not possible in the simple or cavernous forms. Partial removal of deep wedges is disappointing in result, and there is danger of inflammation and lymph fistula. The repeated injection of irritants may cause some diminution in size. Cauterization should be discarded; also ligation of the blood supply of the part, as the latter does no good and may result in gangrene.

The following case presented some unique points of interest, and is reported for statistical purposes:

Case No. 33,729, Ronald R., was admitted to my service at Wesley Hospital, September, 1911. The patient, a two year old boy, is normal in every way, except for the condition of the right lower extremity. The father stated that labor had been normal and that the enlargement of the limb was noted at birth. As nearly as could be ascertained, the rate of growth of the enlargement was proportionate to the growth

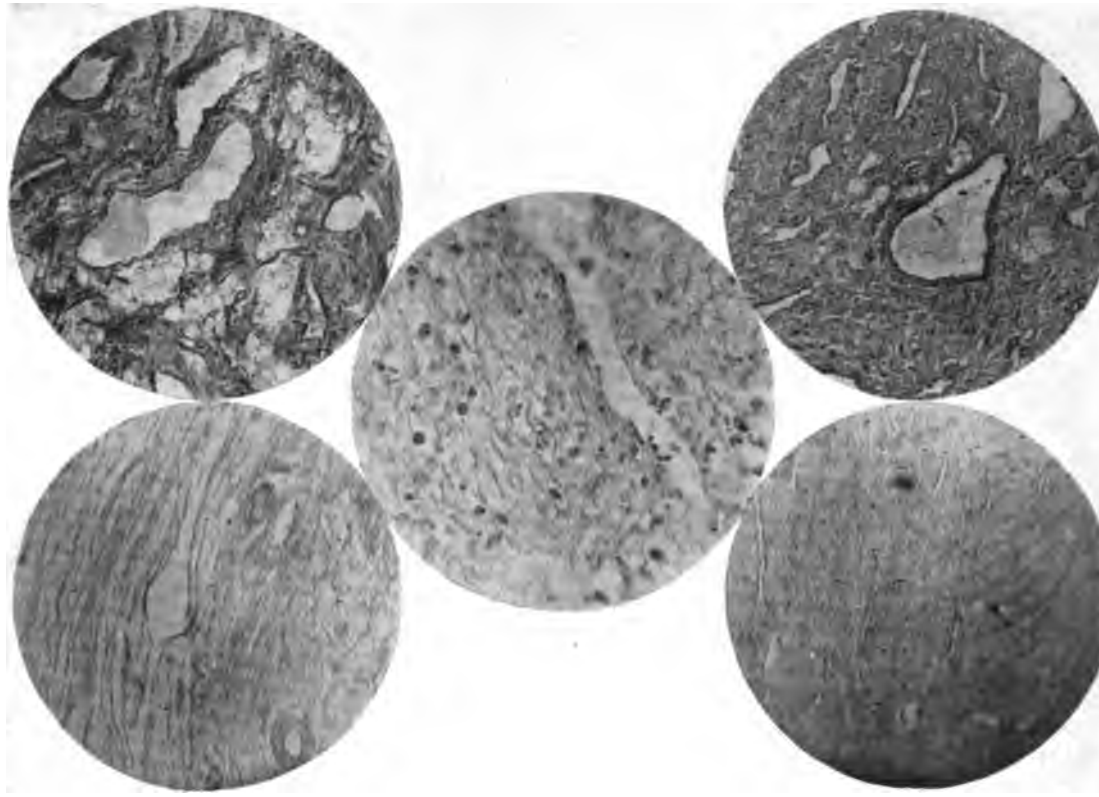


Fig. 5.
Fig. 6.

Fig. 4.

Fig. 7.
Fig. 8.

Fig. 4. High power magnification obj. 2/6 showing dilated lymph-channel surrounded by loose connective-tissue stroma in which there is round-cell and plasma-cell infiltration. Fig. 5. Lymphangiectases in the deeper, loose connective tissue. Fig. 6. A portion of tissue from the deep layers showing loose meshwork of connective tissue and dilated lymph-vessels, obj. 2/3. Fig. 7. Low power magnification obj. 2/3. Dense connective tissue undergoing hyaline degeneration. Marked lymph-angiectases. Fig. 8. Low power magnification obj. 2/3. A portion of the tissue near the surface showing fibroma-like character.

of the rest of the body and limb. Examination revealed a large lobulated mass on the right thigh and posterior aspect of leg. It is firm, inelastic and attached to the skin, the whole mass moving freely on the deep tissues. Figs. 1, 2 and 3 give the idea of its shape, size and position. The limbs were of equal length, and, except for a little awkwardness, the child walks without difficulty. There was nothing in the family history that had any bearing on the pathogenesis. A skiagraph showed the bones of the leg to be unaffected.

The patient was anæsthetized and a free incision made over the posterior aspect of the tumor mass. It was found firmly fixed to the skin throughout its entire extent, but separated rather easily from the deep fascia. It was possible to remove a large part of the mass and cover in the defect with the remaining skin. There was a free escape of a large amount of serum from the wound for a number of days, but it healed without any destructive suppuration. The patient returned home and died of a pneumonia about six months later.

The following is the pathological report, made by Dr. Harry Jackson, of the Pathological Department of Northwestern University Medical School:

PATHOLOGICAL REPORT OF A CASE OF ELEPHANTIASIS CONGENITALIS LYMPHANGIECTATICA FOR DR. BESLEY.

According to Kaufman, elephantiasis may be classified etiologically as elephantiasis congenitalis and elephantiasis acquisita.

Elephantiasis congenitalis may also be hereditary and it usually appears as tumor-

like swellings of the skin which are partly fibromas with lymphangiectases, and partly neurofibromas. Elephantiasis acquisita may be of the tropical type, which is endemic in tropical countries, and is due to the filaria sanguinis hominis. These organisms block up the lymph channels and appear in the blood-stream during sleep.

Elephantiasis nostra is the acquired type usually found with us, and occurs after chronic or recurring inflammations of the skin. It has been found after erysipelas, lymphangitis, eczema, tuberculosis and syphilis. With the removal of the lymph glands, for instance of the groin, elephantiasis has been produced in the penis and scrotum.

*Location.* Elephantiasis is most commonly seen in the lower extremities and in the male and female genitalia. It may occur in the lips and tongue, as macrocheilia and macroglossia. It affects the epidermis, cutis and subcutis, with an increase of the connective tissue and a widening of the lymph channels, while the muscle, fat and nerves are destroyed.

*Varieties.* According to consistency, we have:

Elephantiasis dura, a form in which the connective tissue is very dense, and gives to the tissues a hard consistency.

Elephantiasis mollis, which has an œdematous connective tissue which is grayish white in color.

A study of the surface allows of the following classification:

Elephantiasis glabra, in which the skin is smooth.

Elephantiasis verrucosa, in which the skin is rough and warty.

Elephantiasis tuberosa. Here the skin is in thick plaques presenting an appearance resembling ichthyosis.

Elephantiasis nigra, with pigmented skin.

Elephantiasis lymphangiectatica, a variety in which the lymphatic spaces are dilated or varicose, and from which one can squeeze a milky fluid.

*Description of a portion of the excised tissue.* Grossly, the skin appears thickened and reticulated. From the meshwork a thin, milky fluid can be expressed. There is considerable adipose tissue present. Near the skin surface, the tissue is dense and the lymphatic spaces are small. Deeper, the tissue is loose and soft in consistency, the lymphatic spaces larger, and the fluid content greater in amount.

Microscopically, the superficial portion of the section which, on gross examination, was so dense is seen to be made up of connective-tissue bundles undergoing hyaline degeneration. The lymph sinuses, lined by a single layer of endothelial cells, are dilated and irregular in shape and fairly numerous. Some of them contain a granular debris, lymphocytes and some red blood cells. In the connective tissue are accumulations of small round-cells. The blood vessels show passive hyperæmia.

In the deeper portion of the section, the connective tissue is arranged in a loose meshwork throughout which there is considerable adipose tissue. The lymph channels are widely dilated. Some are compressed and appear long and narrow, while others are irregular and tortuous and show dilatations. A few large round-cells are scattered throughout this tissue, and there is much œdema. In this tissue, deeply placed, are also seen isolated bundles of muscle fibers.

# FREE TRANSPLANTATION OF FASCIA[1]

By EDMOND M. VON EBERTS, M. D., and W. H P HILL, M. D , Montreal

THE feasibility of transplanting tendon was demonstrated in 1881 by Gluck, who transferred a segment of tendon from one fowl to another without loss of function. In 1887 Peyrot transplanted a piece of tendon 4 cm. in length from a dog to a tendon defect in the finger; the transplant healed in position and function was partially restored. About the same time Monod obtained a perfect functional result by transplanting a rabbit tendon to a defect in the flexor longus pollicis of a human patient. Mainzer in 1902 reported two cases in which union occurred in homotransplants used in the bridging of tendon defects. Following the publication of von Hacker's work upon the autoplastic repair of tendons, however, attention was directly chiefly to his method. The experimental work of Martin Kirschner gave renewed impetus to the whole subject of free tendon and fascia transplantation, and latterly not only has a considerable amount of confirmatory experimental work been done but the practical application has also been put to the test.

Our work was carried out in the Department of Experimental Medicine at McGill University during the early months of 1912. It consisted in the transplantation of a segment of fascia lata from one dog to an artificially prepared defect in either the tendo Achillis, the dura mater, or the peritoneum of the same dog. Twenty-six operations in all were done, and they are described here in three groups.

## GROUP I

In the first group of nine experiments a segment of fascia lata was transferred to an artificial defect in the tendo Achillis. The technique was as follows: The tendo Achillis in one leg was exposed by a lateral incision, a retention suture of chromicized catgut inserted, and the segment of tendon included in the suture excised. An incision was then made over the iliotibial band and a piece of fascia removed, 1 cm. longer than the tendon defect and wide enough to form a cylinder of the same circumference as the excised tendon. This flap was next rapidly transferred and sutured with fine chromicized gut around the tendon stumps, the retention suture being included within the cylinder. Finally, the tendon sheath was sutured with fine catgut. The muscular surface of the fascia was turned outward as being that surface less likely to form adhesions with the tendon sheath. This method of procedure was followed in seven cases. In the other two, instead of the ends of the stumps being included within the cylinder of fascia, end-to-end suture of the graft to the tendon stumps was performed.

*Results.* In six of the seven cases done by the first method lengthening was entirely prevented and function was regained wholly or in part, according to the lapse of time between the operation and the destruction of the animal. In the seventh case, as the suture between the fascial graft and the lower stump did not hold, there was slight lengthening but comparatively little loss of function. In the two cases done by the second method the yielding of the sutures led to permanent lengthening of the tendon, and there was, consequently, only partial restoration of function.

Following the grafting of fascia in such a position, there is at first a marked thickening owing to exudation within the tendon sheath and to proliferative changes in the surrounding tissues. This thickening about the graft subsides gradually, and with its subsidence there is a concomitant improvement in function, until finally normal movements are restored. The dog from which specimen No. 7 (Fig. 1-b) was taken was killed 33 days after operation, at which time, although there was still a slight limp, the animal was able to stand on its hind legs and jump about without evident pain or discomfort. There was no deformity. In animal No. 24 (Fig. 2), killed six and two-thirds months after operation, there was complete restoration of function.

Specimens were taken from all the animals in this group except one, and each specimen

[1] Read before the Montreal Medico-Chirurgical Society. December 6. 1912.

(c) (b) (a)

Fig. 1. a, Tendon defect allowed to heal without grafting; shows marked lengthening of the tendo achillis; b, grafted tendon 33 days after operation; shows marked thickening of the tendon; moderate grade of muscular atrophy. Tendon normal in length; c, normal tendon.

shows that the graft retained its normal gross and microscopical appearance.

The comparison of a tendon in which the defect has not been repaired (Fig. 1-a) with one in which it has been repaired by a graft (Fig. 1-b) proves at once the value of the graft. Undue lengthening and loss of function in the tendon have been prevented. A further comparison of the grafted tendon (Fig. 1-b) with the normal tendon (Fig. 1-c) shows that there is no lengthening whatever.

Fig. 2. Grafted left and normal right tendon from dog killed six and three-fourths months after operation showing normal length of grafted tendon, slight thickening at the site of the graft, and slight muscular atrophy. In this case there was complete restoration of function.

Microscopical preparations from these grafts show unaltered fascial elements, that is, fascial fibers or bundles of fibers with unaltered staining reaction of the component cells. In grafts removed a few days after operation there is seen, in varying degrees, an inflammatory reaction, chiefly evident in the space between the tendon sheath and the transplant, and characterized by the exudation of lymph and the proliferation of connective-tissue cells derived from the inner surface of the tendon sheath. There is a similar though less marked inflammatory

Fig. 3

Fig. 4

Fig. 3. Specimen showing dural graft. A few adhesions were present at the center of the graft, beneath which at the time of operation, owing to hæmorrhage, a cortical vessel had to be ligated. There are, however, no adhesions along the line of union of the graft with the dura mater.

Fig. 4. Fascial graft of the meninges viewed from within the skull. Complete absence of adhesions between pia arachnoid and graft.

reaction in the tendon sheath itself and in the tissues immediately surrounding it, the whole representing the early inflammatory changes which are responsible for the marked thickening that shortly follows operation and, in the final stages, for the permanent thickening that is usually present in a greater or less degree. There are no signs of vascular invasion of the graft nor of multiplication of the fascia cells. On the other hand there is no necrosis. The grafts are apparently kept alive purely by lymph seepage.

GROUP II

In the second group of three experiments, segments of fascia lata were transplanted to artificial defects in the dura mater and sutured into place with silk thread. One of the animals died of œdema of the lungs at the conclusion of the operation. Photographs of specimens from the other two animals are here shown. In one (Fig. 3) there are a few adhesions at the center of the graft, beneath which, at the time of operation, a cortical vessel had to be ligated owing to hæmorrhage. There are, however, no adhesions along the line of union of the graft with the dura mater. In the second specimen (Fig. 4) there is perfect union, and adhesions have not formed between the pia arachnoid and the graft. In these cases the muscular surface of the fascia was turned toward the brain. The outer surface of the transplant became adherent to the overlying temporal muscle. Convalescence was uninterrupted. As it was thought more desirable to show the grafts in position, a microscopical examination of the transplants was not made.

GROUP III

In the third group of 14 experiments, segments of fascia were transplanted to artificially prepared peritoneal defects. The muscular surface of the grafts was turned toward the peritoneal cavity. Although there was no injury to the surface of the grafts and no unnecessary exposure of the tissues to the air, adhesions of varying extent formed in all of these cases between the inner surface of the graft and the great omentum. Preventive measures, such as smearing the inner surface of the graft and the suture line with vaseline, flooding the field of operation with saline, packing off the intestinal coils presenting with vaselined silk tampons, and everting the peritoneum and margins of the graft by means of Mayo's stitch, all proved without avail. It may be said, however, that in the dog a suture of the peritoneum in the neighborhood of the median line can rarely if ever be performed without the occurrence of such adhesions. In all of these cases, with the exception of one in which failure of the intratracheal insufflation apparatus caused a break in the technique, the wounds healed by first intention. Microscopical slides prepared from the grafts implanted in the parietal peritoneum show the unaltered state of the fascial elements and the inflammatory changes associated with the adhesion formation between the graft and the omentum.

The success of experimental work upon the free transplantation of fascia and tendon has led to its practical application in the repair of tendinous and muscular defects and in the closure of hernial orifices where other methods have failed or are likely to fail. It is now generally believed that the lack of success met with formerly in tendon grafting was due to faulty surgical technique and not to the presence of a detached tissue element, that is, one without direct vascular connection. The fact that such grafting is now successfully performed speaks volumes for the technique of the modern experimental laboratory.

In the human subject, material for transplantation is usually obtained from the fascia lata. After the field to which the graft is to be transferred has been prepared, a curved incision with convexity forward is made on the postero-external aspect of the lower third of the thigh and the necessary amount of fascia stripped from the underlying muscles. This is then transferred quickly and sutured into position. The raising of the fascial flap should be effected without scoring or other injury to its inner or muscular surface. The muscular surface of the transplant should be turned outward, since under normal conditions this surface glides over the muscles and shows less tendency to form adhesions than does the outer surface — a factor of especial

importance in the repair of tendons. After the main operation is completed, the wound in the thigh is closed with skin sutures. No attempt is made to obliterate the fascial defect, partly because in most cases it is impossible to do so, and also because experience has shown that the presence of such a defect is in no way detrimental to the function of the underlying muscles.

Fascial grafts heal without reaction and without appreciable diminution in size, the two requisites being, of course, the avoidance of unnecessary mechanical injury to the tissues and the observance of a strictly aseptic technique. Failure owing to infection is naturally more likely to occur in non-aseptic cases, but even in such cases, in which defects in the intestinal canal, the urinary passages, and the trachea, have been repaired, and in one case of ectopia vesicæ in which a large area of the transplanted fascia necessarily remained exposed, prompt healing has occurred.

Since the publication of his experimental work Kirschner has employed extensive fascial transplants in man in 40 cases and has observed its use by others in 10 cases. In every case the transplanted fascia has met the demands made upon it. For the fascial repair of tendon defects Kirschner recommends, in a recent publication, the technique employed by us in our experimental work, that is, the inclusion of a considerable portion of both tendon stumps within the ends of the cylinder of fascia; and he points out that by this means tension may be avoided and the danger of suture failure very greatly lessened.

Since the appearance of Kirschner's work we have had an opportunity of employing a free fascial transplant in the repair of a defect of the abdominal muscles following appendicectomy. The history of the case is as follows.

J. L. L., aged 23 years, was admitted to the Montreal General Hospital on June 22, 1911, on the third day of an attack of acute appendicitis.

Under morphine gr. 1/6 and nitrous oxide-oxygen anæsthesia, the usual incision for appendicectomy was made. The internal abdominal oblique was found to be œdematous. An area of the transversalis fascia and the peritoneum 6 cm. vertically by 3 cm. transversely was entirely necrotic, and immediately beneath these necrotic layers, lying in an abscess cavity, was a perforated gangrenous appendix. The appendix was removed and a drainage tube inserted. The two outer muscular layers were brought together with interrupted catgut sutures, and interrupted silkworm-gut sutures were placed in the skin. On the eleventh day after operation, as there was complete obstruction of the bowel, an incision was made in the median line and a large pelvic abscess was evacuated. A second abscess was evacuated by digital exploration through the original appendicectomy wound. From this time convalescence was uninterrupted.

On February 2, 1912, the patient returned for the removal of the scar and the repair of the original appendicectomy wound. Under morphine gr. ¼ and nitrous oxide-oxygen anæsthesia the scar tissue was excised, and the edges of the external and internal abdominal oblique muscles in the path of the scar were freshened and retracted, exposing a wide defect in the transversalis fascia. A flap of fascia 4 by 6 cm. in area was then removed from the anterior surface of the right rectus abdominalis muscle and sutured with fine chromicized gut into this defect. The internal and external abdominal oblique muscles were next sutured with interrupted catgut over this fascial flap, the whole forming a firm, resistant covering to the peritoneal and transversalis defect. The wound healed without reaction and the patient has since been free from any sense of weakness in the abdominal parietes.

## BIBLIOGRAPHY

1. Gluck. Über Muskel und Sehnenplastik. Arch. f. klin. Chir., 1881, xxvi, 61. Cited by Lewis and Davis, J. Am. M. Ass., 1911, lvii, 540.

2. Peyrot. Transplantation chez l'homme d'un tendon emprunté à un chien. Bull. et mém. de la Soc. de chir. de Paris, xii, 356. Reviewed in Zentralbl f. Chir., 1887, No. 20, p. 392.

3. Monod. Plaie des Tendons. Greffe Tendineuse. Bull. et mém. de la Soc. de chir. de Paris, xiii, 397. Reviewed in Zentralbl. f. Chir., 1887, No. 51, p. 959.

4. Mainzer. Über indirekte Sehnenüberpflanzung nebst Bemerkungen über die physiologische Grundlage der Sehnenüberpflanzungen. München. med. Wchnschr., 1902, xlix, p. 869.

5. von Hackner. Über ein neues Verfahren der Sehnenplastik am Fingerrücken. Wien. klin. Wchnschr., 1898, xi, 2. Reviewed in Schmidt's Jahrbücher, 1898, cclviii, 248.

Über den autoplastischen Ersatz der Streck und der Beugesehnen der Finger durch entbehrliche Sehnen des Handrückens. Beit. z. klin. Chir., 1910, lxvi, 259.

6. Kirschner. Über freie Sehnen- und Fascientransplantation. Beit. z. klin. Chir., 1909, lxv, 472. Die praktischen Ergebnisse der freien Fascientransplantation. Arch. f. klin. Chir., 1910, xcii, 888.

Die freie Transplantation von Fascien. Therap. Monatsh., 1911, xxv, Heft 12, 711.

Lewis and Davis. Experimental Direct Transplantation of Tendon and Fascia. J. Am. M. Ass., 1911, lvii, 540.

Davis. The Transplantation of Free Flaps of Fascia. Bull. Johns Hopkins Hosp., 1911, xxii, 372.

# A SUMMING UP OF THE GOITER QUESTION[1]

By C. H. MAYO, M. D., Rochester, Minnesota

CONCERNING the development of the thyroid, embryologists have returned to their former belief that the gland is developed from a single instead of three anlage. It originates between the three portions of the developing tongue and early descends to its final resting place upon the trachea. The tubular line of descent is known as the thyroglossal duct and early undergoes obliteration. The remains of this structure often persist at the posterior portion of the tongue the foramen cæcum. Gaskell has shown, however, that in the higher invertebrates the duct persists as such and in great part delivers into the genital tract, the analog of the thyroid thus being evidently a sex gland. Occasionally the gland remains in the tongue as a lingual thyroid; again, portions are separated in descent as aberrant thyroids, or partially attached as accessory thyroids, while the midline cysts are usually due to the persistence of pharyngeal embryonic mucosa carried down in the thyroglossal duct by the descending gland.

The gland, horseshoe in shape and consisting of two lobes connected by an isthmus, rests astride the trachea, to which it is quite firmly attached by its capsule. No other organ in the human body is so well provided with a blood supply. In proportion to its weight it receives 28 times as much blood as the head, and all the blood in the body passes through it, as it does through the brain, once every hour. It has been shown to be five and a half times more vascular than the kidney. While the lymphatics are numerous, those leaving the gland are small as compared with its wonderful blood supply, apparent activity, and production of secretion. It is probable, however, that this secretion is delivered into the veins by short lymph spaces throughout the gland itself. Baumann showed long ago that there was a high iodine content in the human thyroid. There is much less in herbivorous animals. Marine has done much work on the iodine content of the thyroid in warm-blooded animals and fish. Hunt and Smith have carried on biochemic tests for the same substance.

The secretion of the thyroid is thin, watery, and non-stainable, and it is probable that the active cells represented by one-sixth of the gland are sufficient to furnish the necessary amount of secretion for the preservation of good health.

As has been stated, the gland in the higher invertebrates is apparently a sex organ. To some extent this relationship holds through vertebrates, including man. At the period of puberty some increase in the size of the gland is quite common. This is often noted during menstruation, and especially during pregnancy; while at the menopause many of the symptoms are apparently those of alternate hyper- and hypoactivity of the thyroid, as shown by its effect upon the nervous and circulatory systems and nutrition. While it is probably as active in the control of early growth, both mental and physical, as is the thymus, a child born without a thyroid fails to develop mentally or physically; and its loss in the adult usually leads to a peculiar deterioration known as myxœdema.

The variations in the gland without symptoms are so great that it is almost impossible to state what is normal thyroid. Undoubtedly the gland has a considerable storage function, and when this is carried to excess it leads to local areas of stasis due to pressure atrophy of the producing cells. Such glands constitute many of the atoxic (simple) goiters, though here also are included some of the encapsulated adenomata of both adult and fœtal type. Colloid, then, may not be an essential secretion, but a spongy holding material thrown out by the gland in exerting its storage function.

In exophthalmic goiter — so-called hyperthyroidism — there is always a true hypertrophy and hyperplasia, an increase in the cells and activity of the gland. Atoxic (simple) goiter includes about all varieties not inflammatory, exophthalmic or malignant, yet in this group have been included a large

[1] Read before the Clinical Congress of Surgeons of North America, Chicago, November 14, 1913.

number of cases of toxic thyroid due to degeneration of the gland and presenting many of the symptoms of exophthalmic goiter, particularly those of the cardiovascular systems, but always without protruding eyes. These cases, in Europe, are frequently classed as pseudo-exophthalmic goiter.

In simple goiter there is the enlargement of the thyroid, which may follow its normal contour or occur in the isthmus or either lobe and present the colloid type. It may also be an encapsulated adenoma representing a rounded tumor of the whole gland or any portion of it. The sudden appearance of a tumor of the thyroid with symptoms of pressure may come from internal hæmorrhage or from active hyperæmia, while infections with severe, acute symptoms of toxæmia are but rarely seen.

Substernal goiter is noted in about one in forty cases of simple goiter; slight substernal projections occur much more frequently. They are diagnosed by symptoms of respiratory pressure, prominent veins extending from the neck down onto the chest, by percussion, and by the röntgenogram. The very large ones are fortunately of the encapsulated adenoma type, admitting of enucleation.

Simple goiters are subject to changes of the cystic type, especially the encapsulated adenomata, while fibrous and calcareous degenerations are seen, and some cases present all varieties.

Exophthalmic goiter presents a fairly sharp clinical picture. Its onset, as a rule, is relatively acute and the course of the disease fairly definite. Early in the history, the clinical picture is that of a toxin acting directly on the more vital organs, more notably the central nervous and vascular systems. Later it is made more complex by the interaction of those organs whose functions have been directly disturbed by the toxin. The order of onset of the more important symptoms based on the average of our series is as follows: (1) cerebral stimulation, (2) vasomotor disturbances of the skin, (3) tremor, (4) mental irritability, (5) tachycardia, (6) loss of weight, (7) cardiac insufficiency, (8) exophthalmos, (9) diarrhœa, (10) vomiting, (11) mental depression, (12) jaundice, and (13) death. In some cases certain of the symptoms may not be present in the early stages of the disease, which makes the condition difficult to diagnose. There are certain conditions of the nervous system of unknown origin, which much resemble this disease. As a rule, however, these patients have symptoms extending over many months. They have neither exophthalmos nor an increase in the size or density of the gland, and are not benefited by operation on the gland.

In carcinoma and sarcoma of the thyroid the picture is usually one of rapid growth of the gland, which becomes hard, and irregular, often with neighboring glandular involvement. These symptoms may also occur in a simple goiter of long standing, however. Because of lymphatic and venous delivery with the early capillary involvement, early metastases in glands and lungs are common and local recurrence is the rule. In such cases, when the disease is confined within the capsule, treatment requires removal of the entire gland.

Because of their interrelationship in function and location, the parathyroids and the thymus are considered in relation to the diseases and especially to the surgery of the thyroid. The parathyroids are usually four in number, a superior pair and an inferior pair. They are situated on each side and behind the thyroid, but intimately connected with its capsule. Much is attributed to the action of these little bodies in maintaining the equilibrium of the mineral salts of the body, especially of the calcium. Experimental evidence shows that, when removed from animals, a condition of muscular spasm known as tetany develops, following a rapid loss of the mineral salts. The blood supply consists of terminal branches from the vascular anastomosis between the inferior and superior thyroid arteries. Their veins have no valves. Thus they frequently become injured by hæmorrhage during the congestion occurring at birth, to which is attributed infantile tetany and also tetanic attacks of later childhood and even of adult life. Tetany following operation is apparently associated with their removal or an injury to their blood supply,

associated with a great loss of thyroid tissue. In such cases the best treatment is the feeding of fresh beef parathyroids, and, following MacCallum's plan, the restoration of calcium to the body, preferably through the administration of calcium lactate in 5 per cent solution, at repeated intervals. In addition to this, the feeding of thyroid is indicated, and some cases are reported as benefited by the parathyroid serum.

The thymus is believed by some physiologists to be a gland of marked interrelationship with the thyroid in the growth of the body, and in the hyperplasia of the thyroid the thymus is usually found enlarged. While this is true of the majority of cases, it by no means holds good in many of the most serious cases, as shown at autopsy following both medical and surgical deaths of these individuals.

The thyroid consists of a great number of groups of cells which may be found even in the adult in various stages of development, from unarranged embryonic cells, Wolfler's rests, to well-developed follicles lined with epithelium, secreting into a well-marked central cavity. The simplest change is hyperæmia, which may be temporary, occurring through the nervous system or more prolonged through systemic infection. It may be sufficient, however, to produce hæmorrhage within the gland.

Acute inflammation of the thyroid may occur as the result of traumatism or general bacterial disease. Progressive hyperplasia consists in an increase in the number of parenchymatous cells, usually of a hypertrophic type, either in single or multiple layers. This may occur in parts of the gland or throughout all of it. True adenomata of the thyroid can be identified only when encapsulated. Histologically they are either fœtal adenomata, the parenchyma of the true fœtal type, or adult adenomata in which the parenchyma has taken on adult characteristics, i.e., follicles lined with cells of adult type and subject to all the changes which are noted in the thyroid outside of encapsulated tumors, that is, the various degenerations.

Of the retrogressive changes, retention of secretion is the more common, the simpler, and the more nearly normal physiologic state, as the thyroid is not only an actively secreting organ, but normally has a storage function. Colloid appears to be the basis for the preservation of this secretion. When it occurs in excess, the condition is pathologic and leads to degeneration or atrophy of cells.

Atrophy of the thyroid results from overwork, pressure, and lack of nutrition to the gland. Simple goiter may undergo such a degeneration from these causes and in the production of toxic materials so affect the circulatory and nervous systems that the condition resembles the more severe toxic state of exophthalmic goiter, or in fact any chronic toxæmia.

To a variable degree thyroid enlargement may be due to demands made upon its secretion by certain systemic conditions, such as sexual development at puberty, the goiter of adolescence, the enlargement or hyperæmia at menstruation, enlargement in the latter part of pregnancy, the changes at the menopause, and last, but not least, the possible iodine demand occasioned by bacterial infection of various organs.

Accumulated evidence shows that endemic goiter frequently comes from a water-borne irritant. In such cases ensuing chronic intestinal toxæmia may occasion the extra demand on the thyroid. McCarrison in his investigations of the subject in India, has done much to prove this.

The various types of goiter should be treated both medically and surgically. Many goiters of the simple and mild exophthalmic type undoubtedly recur spontaneously, although various forms of medical treatment may hasten the recovery and restoration of the gland to an apparently normal condition in many instances, especially in the early stages of simple goiter.

Simple colloid goiter which has resisted treatment and encapsulated adenomata are in most instances best treated by removal of the diseased portion of the gland with preservation of its better portions. If the diseased part is not removed, such glands will later in life expose the individual to a serious menace, since the degeneration which follows in an average time of about fourteen years may be of such a character as to permanently damage

the heart, kidneys, and liver. During middle life such degeneration frequently follows the ill-advised use of iodine; the severity of the toxic process places these patients on a par with the severe types of exophthalmic goiter. Plummer has shown a great similarity in the damage to the essential organs of the body, such as the heart, kidney, and liver, by various forms of toxæmia. In exophthalmic goiter, however, the essential condition identifying it from all other toxæmias is the parenchymatous increase of the thyroid. Exophthalmos occurs in no other systemic condition. The staring eye (Stellwag) and the widening of the palpebral fissure (Dalrymple) may occur with other toxic myocardial lesions, especially that of advanced Bright's disease. Exophthalmic goiter is essentially a disease of a chronic character, presenting exacerbations and ameliorations of symptoms extending over a period of months or several years. After the first year the gland often undergoes a regression.

While this disease is amenable to surgical treatment by the removal of a large amount of the hypersecreting gland, it is by no means emergent surgery, and all patients, during periods of exacerbation, should be considered as medical cases. Surgery is indicated in the up-wave of improvement. The majority of these patients can withstand thyroidectomy at the time they are seen by the surgeon. Extreme conditions, especially dilatation of the heart, may require medical preparation, and the operative interference following in cases resistant to treatment should be confined to injections of boiling water into the gland after Porter's plan to hasten improvement. In most of the severe cases a ligation is made, first, of the left upper pole only. Should the reaction following this be severe, the ligation of the right upper pole is indicated a week later, and thyroidectomy reserved until four months have elapsed, by which time these patients have made an average gain of 22 pounds, with great general improvement. However, if the reaction following the left ligation is not unduly severe, a partial thyroidectomy may be made at the second operation the week following.

In operating, the best exposure of the thyroid is obtained by a curved transverse incision through skin and platysma, extending between the anterior jugular veins with wide separation of the flaps, midline vertical division of the muscles exposing the thyroid. If division of the muscle be necessary, it should be made at the upper part of the dissection to break the line of scar and preserve muscle-function. In some cases the wound may be closed without drainage, the cavity being filled with salt solution. As a rule, however, patients having tubular drainage for 24 hours are more comfortable. A subcuticular closure of the wound with catgut, approximating first the platysma muscle, secures an almost imperceptible scar.

The anæsthetic of choice in most instances is ether. Complicated cases, however, may be best carried through the operation by the local use of 0.5 per cent novocaine solution with the addition of a little adrenalin. Occasionally the combined use of a local with a general anæsthetic is advisable, the local anæsthetic, relieving the pain, necessitates less of the general anæsthetic to secure sleep.

In severe forms of Graves' disease the use of 1/200 grain of scopolamine with 1/6 grain of morphine one hour previous to operation is often a distinct advantage. Some patients seem to have an idiosyncrasy to the drug, and in such cases the operation must be postponed 24 hours to permit elimination. In all cases in which ether is used as the general anæsthetic, 1/200 of a grain of atropine should be given one-half hour before the operation, to maintain a dry trachea and pharynx during the operative procedure.

## REFERENCES


BAUMANN. München. med. Wchnschr., 1896, xliii, 309, 398, 476, 1153.

CRILE. Surg., Gynec. & Obst., 1911, xiii, 170–173.

GASKELL. "The Origin of Vertebrates," 1908.

HUNT. J. Am. M. Ass., 1907, xlix, 1323–1329.

MACCALLUM. Bull. Johns Hopkins Hosp., 1908, xxiii, 416–422.

MARINE. J. Am. M. Ass., Aug. 3,1912. 325–327.

MCCARRISON. "The Etiology of Endemic Goiter," 1913.

PLUMMER. J. Am. M. Ass., 1913, lxi, 650–651.

PORTER. J. Am. M. Ass., 1913, lxi, 88.

SMITH. J. Am. M. Ass., 1914, xlii pp 113–116.

# A RUBBER TUBE IN THE RECONSTRUCTION OF AN OBLITERATED BILE-DUCT: AN HEPATICODUODENOSTOMY

By ARTHUR T. MANN, M. D., F. A. C. S., Minneapolis
Assistant Professor of Surgery, Minnesota Medical School; Senior Surgeon in charge of the University Surgical Division of the City Hospital; Surgeon to the Northwestern Hospital

THE use of a rubber tube to assist in the replacement of a common bile-duct occurred in a young woman of 28 years as the result of cicatricial contraction and obliteration of the common duct following infection and sloughing due to the damaging presence of gall-stones.

At the first operation the gall-bladder was found thickened and inflamed like an inflamed and thickened bowel. It was not large but felt almost as solid as a lobe of the liver. It was filled with a septic mucoid material in which there were a number of fair sized stones. The gall-bladder was tortuous, with a sharp bulging letter "S" curve at the base just before its junction with the cystic duct, with two small stones in the lower pocket beyond the reach of the scoop. The gall-bladder was removed, with a portion of the cystic duct, after it had been tied near the common duct with chromic gut. No stones were felt in the common duct, which was traced to the ampulla of Vater, nor in the hepatic ducts. A drainage tube was fastened near the stump with a separate stitch of iodized gut and the abdomen closed in the usual manner.

There was a fair amount of pain the first 48 hours. At the end of this period bile began to flow freely and continued to drain in gradually decreasing amounts until it was about stopped the twenty-sixth day after operation. The wound had healed by first intention up to the drainage opening, but the patient had had more or less nausea and at times periods of vomiting. Her temperature had fluctuated, running to near 103° F. by the third day after the operation, and stayed as high as this for two days more, when it dropped to 101°, and by the fourteenth day to 99°. Meantime the discharge had rapidly assumed the character of the normal bile discharge, with almost no suggestion of pus, and the stools were light brown. The patient vomited on the twenty-second day and did so each day thereafter until the twenty-seventh day, when a large amount of thick gray pus was discharged through the drainage wound, with a temperature running only to 100.4° F. The patient continued to have nausea for some days and occasionally vomited. The stools were of fair color at several days after the operation, but getting lighter and becoming gray by the fourteenth day, after which they varied a little from light brown at the time of the pus discharge to yellow and to gray and back to light brown before she left the hospital. In poor condition at the time of the operation, she was gradually reduced to ninety pounds, though she began to feel better soon afterward. The pus discharge was gradually reduced in amount, and finally became thin and an almost clear fluid (sometimes in large amounts. At the end of the eighth week the dressings were suddenly saturated with bile, with the patient up and about and stools running fairly light. The bile flow was abundant, and gradually lessened during the next three weeks, when the sinus closed and stayed closed.

The patient went to the country and gradually picked up until she considered herself better than she had been for many months, though her strength had not fully returned. About four months after leaving the hospital, a slight jaundice began to show for the first time, and she felt listless and below tone. The jaundice slowly increased over months of time until at about two years from her operation she had the bronzed color of a Mongolian. She suffered from intense and persistent itching, and the stools were of clay color. As this condition had not improved under medical care, a second operation was determined upon to investigate and see if anything could be done to better her condition.

Five months ago this was done. The omentum was found turned upward over the transverse colon, the stomach, and duodenum,

and filling the deep cavity from which the gall-bladder had been excavated. This was loosened, and while the bowels in the general abdominal cavity were found free from adhesions, the tissues in the region of the gall-bladder and bile-ducts were adherent everywhere, and all landmarks were obliterated.

Only those who have been similarly situated can realize what a formidable condition this was to untangle, especially in the absence of the gall-bladder. The under surface of the liver was fastened by a mass of adhesions to the omentum, the duodenum, the stomach, and the gastrohepatic ligament. The foramen of Winslow was obliterated and all tissues were fastened by rather dense adhesions wherever they came in contact with each other. Profuse hæmorrhage welled up from a vein in the region of the gastrohepatic ligament, and it seemed that the portal vein had been opened. With great difficulty this vein was finally traced up to the stomach and was ligated, much to our relief. No common bile-duct was found. A small nipple-like prominence was finally uncovered in the region of the hepatic duct, which looked like a bulging portion of the portal vein. This was investigated most carefully and finally opened; it proved to be the stump of the common hepatic duct. This gave forth a flow of dark bile and mucus, and issued almost at once into the right and the left hepatic ducts. Nothing could be found of the common bile-duct except some indefinite thickening of the fibrous tissue, although the whole region well down behind the duodenum was carefully examined. The hepatic ducts were dilated to a size larger than a lead-pencil. A probe and a small gall-stone scoop dropped easily into both of these ducts from the nipple-like stump which we had opened, but there was no sign of a dimple or an opening into the common duct. This had been obliterated, apparently, as a result of the inflammatory process of two years before. Two stones were recovered from the left hepatic duct, one small, smooth and dark, the other a soft stone mass which could be molded with the fingers.

By this time the patient, who had not been in very good condition before the operation, was showing rather marked symptoms of shock, and it seemed necessary to close the operation as rapidly as possible. The writer decided to substitute a 3/16-inch rubber tube for the common duct. A length of 1¾-inch was taken and passed through a small incision in the convex surface of the duodenum, after the end had been beveled to prevent the swelling of the duodenal mucous membrane from occluding the opening, and after a linen stitch, for security, had been passed through the tube, both ends of which had been passed through the small incision in the duodenum and out through all the coats of the bowel lower down, to be tied later and fasten the tube with its beveled opening toward the bowel lumen. This linen stitch was to serve the purpose, also, of retaining the tube in place until the process of healing was well advanced, and so give the mucous lining of the duodenum and that of the stump of the hepatic duct time to grow toward each other, and so have the process of lining the new tissues which were going to make up the artificial duct well started before the tube could loosen and slip down into the bowel and be passed out of the body.

In order to make something of a papilla to act as a valve and prevent the irritating and infective backflow into the bile-ducts from the duodenum at its periods of increased intra-intestinal pressure during peristalsis, three circular stitches were taken in the duodenum about the rubber tube at different distances, as in the Kader-Senn operation for gastrostomy, making the tube lie in the inverted funnel of the external duodenal wall. The tube was properly turned and the security stitch in its end was now tied.

The opposite end of the tube was inserted into the opening in the stump of the hepatic duct, which was made rather larger than the tube to allow a fairly free drainage of the diseased bile past it and on out of the abdominal drainage wound. The tube fitted into the dilated hepatic duct loosely and would easily permit this drainage. Two mass stitches of celluloid linen were now taken, one on either side of the tube, into the tough scar tissue of the hepatic stump and through the tissues of the duodenum, drawing these

structures firmly into place but leaving a small portion of the circumference open for drainage. A rubber drainage tube was inserted through the abdominal incision down to the region to be drained, but not in contact with the tissues sutured, in order that it might not interfere with the healing in any way.

The patient was in a precarious condition after operation, but finally pulled through a siege of double bronchopneumonia, from which it seemed for a time that we might lose her. Bile flow into the dressings was abundant from the first, and the stools continued of light yellow color for about a week, when they became darker in color. They fluctuated back and forth before they settled down to a normal color, and the amount of bile passed also fluctuated from time to time, being more abundant, as a rule, when the stools were lighter in color. The amount of bile drainage stopped down markedly on the eighth day, and was passed in varying amounts for a week more, when it ceased.

When the tube passed on into the duodenum is not definitely known. All stools were ordered searched, but this was not always done. Our patient was in a low state of vitality, and a sluggish inflammation showed up in the fat layer along on the seventh and eighth days. After this had been healed for some time, a small rounded mass slowly developed deep in the abdomen. This was opened under local anæsthesia, and proved to be an abscess between the omentum and the inner side of the ascending colon, deep in the abdomen. This was of such low virulence that the discharge was practically gone in three days.

The convalescence was slow, but the patient now (five months after the operation) has gained steadily from a weight of 94 pounds to 127 pounds and feels better than she has for three years. She has slowly lost her deep jaundice, until the whites of her eyes are clear; the skin has lost its bronze and the intolerable itching is gone. She is proud of the muscle she has developed in her arms.

It would seem that this method might have some value in some of these difficult cases of reconstruction of the bile ducts. The rubber tube allows the construction of a papilla in the duodenum, which may very well be flattened down and closed by the intra-intestinal pressure during the peristaltic contraction and open again for the passage of bile during the period of relaxation. This would tend to prevent the dilatation of the bile ducts by the back pressure from the duodenum, which has been shown by Coffey [1] and others to take place in experimental work on dogs when a direct anastomosis is made between the open end of a duct and the duodenum. The dilatation in some has been enormous. In one experiment the bile duct was almost as large as the duodenum and almost as thick. If infection and cholangeitis from the backflow of the bowel contents can be prevented in this way, it will be a strong point in favor of the method.

In the next place, even when the duodenum can be brought up to the level of the stump of the common duct, or even of the hepatic duct, the rubber tube simplifies the operation, for the operation of anastomosis by suture alone, with delicate tissues in the stump to work with, at the bottom of the deep and narrow slit between the liver and the surrounding structures, is always a difficult one, if not at times almost impossible. When the distance from the stump of the duct to the duodenum does not allow a safe approximation, the rubber tube allows the surrounding tissues to be drawn about it to form a new tube; or it may be covered with an omental graft, as was suggested by Sullivan after he had used the end of the omentum turned up over the transverse colon for this purpose in his experimental work on dogs; or other tissue transplants might be used, such as peritoneum, superficial fascia or fascia lata.

Dr. George E. Brewer [2] of New York attempted the reconstruction of a bile duct in a patient who had lost most of the common duct from suppuration and gangrene following a removal of the gall-bladder. He followed the suggestion of Sullivan, and after fastening one end of a rubber tube to the interior of the hepatic stump and inserting

[1] Coffey. Ann. Surg., Phila., 1909, p. 1238.
[2] Brewer. Surg., Gynec. & Obst., 1912, xiv, 433.

the other end into the duodenum through a small incision, he wrapped the intervening portion with an omental graft. But he did not construct a papilla nor an oblique passage into the duodenum. This patient died some time later, from what seems to me to have been the result of an ascending infection, and not from occlusion (the reason Brewer gives), for her death came on rather rapidly in an acute attack of distress which followed at some interval two similar attacks from which she had recovered spontaneously.

---

## CONSERVATIVE SURGERY OF THE TESTICLE[1]

BY GRANVILLE MACGOWAN, M. D., LOS ANGELES

IN the quarter of a century or more in which I have been actively engaged in the practice of medicine and surgery, I have witnessed a very great deal of careless and wanton surgical destruction of the essential sexual organs, both of men and women. It is but a few years since it was very dangerous for a woman to complain of any pain in the pelvis or of any semi-hysterical nervous crisis to her family physician or to her surgical consultant. The ovaries were regarded as the prima facie origin of all obscure disturbances of nutrition, intellect, or temperament, and the idea prevailed that by the removal of these organs the re-establishment of physical and mental balance was certain to occur. I have many times stood by the operating table and watched the removal of ovaries that looked to me as normal as it is possible for any organ to be whose periodically recurring functional work monthly contributes to its anatomical deterioration. It seemed to me that such operations, anticipating by years the coming of the menopause, were a social cruelty and unwise surgery.

Fortunately, this method is no longer fashionable, it having almost disappeared from the practice of surgeons of standing; the myriads of little cutters, who imitate like monkeys, now seek to conserve organs which they formerly hastened to annihilate.

The practice of castration of men has never been an extensive one, for the reason that the male almost invariably looks with disfavor upon any operative procedure that robs him of that functional capacity which he values most highly. The consent of women is much more easily obtained to castration than that of men, for obvious reasons. A man knows that if he is deprived of his testicles he will become impotent, and he fears also that his appearance will change in such a manner that his misfortune will be evident to others, but nevertheless, inspired by fear, he will consent to such a mutilation when he believes that the sacrifice will prevent the spread of a dreaded disease or save his life.

So it occurs frequently that testicles are removed when they might very well be saved by the exercise of a patience, skill, surgical ingenuity, and anatomical knowledge that a very large number of persons doing surgery do not possess. Without the testicles, and an unobstructed pathway for the spermatozoa from the testicle to the penis, there is no possibility for a man to become a father. In the absence of the testicle, or in the presence of a distinct degeneration of its glandular tissue, the sexual function, in all cases, becomes weakened, and, in most cases, is entirely lost after a very few years; but it is difficult to say always how much of the secretory structure may be destroyed and yet sexual capacity and potency be preserved.

There are certain diseases of the testicle, as malignant growths, which require the speedy removal of the organ in order to save the life of the individual. These conditions cannot always be recognized by even the most skillful diagnostician until he has explored the organ. But where the patholog-

[1] President's Address, American Urological Association, Boston, April 16, 1913.

ical condition is not clearly defined, and there is a possibility of a mistake in diagnosis by which, in case the organ is not removed, the patient may lose his life, it is best always to sacrifice it, with his consent, and then only if but one of the testicles is involved and the other is healthy.

There are, however, two diseases of frequent occurrence which, with the exception of very rare cases, do not call for castration, and in which it should never be exercised without an effort, or repeated efforts, having been made to save the organ by conservative surgical treatment and by medical measures. I refer to tuberculosis and to syphilis. Where one or both testicles is the seat of pathological change that has not followed a traumatism, in which the testicle, or a portion of it, is indurated and painless, it should always be suspected that such a growth, whether it has been rapid or slow, is luetic; and we are not justified in removing the organ until we have fully tried out all of the modern methods for the treatment of syphilis.

Such growths often occur in young men very suddenly, without any distinct history of syphilitic infection. The world is full of people who have acquired syphilis in an extragenital way and are entirely ignorant of their affliction. They are unable to give any history of a primary lesion. Ignorant, untrained, and unobserving, they may or may not have had distinct skin or mucous membrane lesions, but they cannot tell you—they do not know. It is perfectly possible that a young man may develop gummata in both testicles and in both epididymi without having contracted syphilis at all; he may be the victim of an hereditary lues which has developed very late. It is true that in late hereditary syphilis a careful search will, in most instances, show one or more of its stigmata—there will be, perhaps, faint cicatrices of corneal ulcers long since forgotten, or perhaps never known of by the subject; irregularities in the dental arch; imperfections of the sense of hearing; deformities or deficiencies of the osseous framework dating from early childhood; or definite lesions of the joints pointing to the probability of the existence of hereditary syphilis. If there is a number of children in the family, or if the elders are alive, observing, and truthful, a history of parental syphilis can usually be elicited by the marriage history and confrontation. Yet gummatous lesions may exist in the testicles of boys between 18 and 25 with a very faint or no history of heredity, and they are very difficult to distinguish from malignant tumors.

No testicle should be removed from such a patient until he has been subjected to the modern blood tests for syphilis, to the vigorous use of intramuscular injections of salicylate of mercury or gray oil, and to the intravenous injections of salvarsan or neosalvarsan, together with the administration of ascending doses of iodide of potassium. The treatment should be the same whether a history of syphilis is clear and direct or only surmised or suspected. Whether the disease is acquired or inherited, it is not very likely that gummatous degeneration of the testicle will exist alone; yet it is entirely possible that, at least at the time of the primary observation, such a thing may occur. I am sure that I have seen it. It is very seldom that syphilitic testicles do not clear up under a thorough antisyphilitic medication; yet sometimes they do not, because the blood-vessel supply and lymph-channels are blocked by the pressure of thick-walled hydroceles of the tunica or adhesions. In such a case, recourse must be had to conservative surgical measures. In this connection, I will report a case.

About fifteen years ago, a very successful young New York publisher, 30 years of age, applied to me for the treatment of his lues. He had multiple tertiary lesions. These consisted of serpiginous ulcers upon the back, chest, and both thighs, a scaly palmar syphilide, gummatous nodes upon both tibiæ, the sternum, the soft palate, and in both testicles; associated with this were an intense cachexia, profound anæmia, and a slowly progressing dementia. This man knew the nature of his disease; he had been sent to California to hide from his friends and relatives, and had been referred to me for treatment. The testicular tumor on each side was firmly adherent to the tensely stretched skin, and probably was ten times the size of an ordinary testicle, hard and indurated like ivory; but at the upper portion of each it seemed to me I could detect at times slight fluctuation.

The mental habit of this individual was such that

he paid very little attention to his skin and his bones and to the threatened perforation of his palate; his whole mental concern seemed concentrated upon the probable loss of his testicles, and I could only get him to consent to systematic treatment by continuously keeping before him the fact that his disease would, if not vigorously opposed, in all probability unsex him. He was given daily injections of one-seventh grain of bichloride of mercury deep into the muscular tissues of the back. This old-fashioned treatment, while it is very effectual, is extremely painful at times, so that I had great difficulty in keeping him to it. Iodide of potassium was given in ascending doses until he was eventually taking 40 gm. per day. All of the skin and bone lesions cleared up in a month. The mental symptoms, which were more those of endarteritis than actual luetic degeneration of brain tissue, also rapidly improved, so that his mental powers returned to practically their full vigor; but the syphilitic infiltration of the testicles was not in any way affected by the treatment — neither became softer, and neither became smaller. He was very much depressed by this incident, and one day suggested to me that I explore one of the testicles and find out whether there was any chance of it ever becoming useful. He thought, perhaps, that if the tension were relieved the medical measures might have a better opportunity to become successful.

The normal cellular tissue which one finds between the dartos and the tunica had been changed into a thick, fibrous mass. On the right side the tunica vaginalis, at its lower and middle portion, had adhered to the testicle and had become obliterated entirely; at the upper part it had formed a dense sac, enough of the sera being left to make a hydrocele partially enveloping the cord. It contained about 30 ccm. of fluid, and was under very high pressure, being kept tense by the thick sac on the outside and by the gummæ in the epididymis and the testicle on the inside. This was laid open freely and the remains of the tunica dissected away, and the hard fibrous adhesions between the sac and the testicle below were broken up by blunt dissection. A much smaller hydrocele was found in a similar position in the left testicle. More of the tunica was obliterated on this side, and the adhesions were closer between the fibrocellular envelope and the testicle; these also were broken up and dissected out. The testicle on the left side was smaller and not so tense. Softening had not taken place in the gummata in either testicle. The skin and the remains of the sac on both sides were stitched together and the cavities packed with iodoform gauze. We then continued the treatments with the sublimate and iodide. Within a few hours after the removal of the tension the condition of the testicle commenced to improve, and inside of two weeks the gummata had completely disappeared and the testicles were restored to the consistency of normal glands.

This gentleman remained under my care for a year, and at the end of that period he seemed to be entirely well, judged by the standards which we then had for ascertaining the success of our treatment. I instructed him to continue the use of mercury by the mouth, under the guidance of a New York physician, for four years. In the interval I frequently heard from him, and during that period of time he had no recurrence of any symptoms which his physician could detect as syphilitic. At the end of five years he married, and two years later I received a photograph of himself and his wife and a very healthy looking boy baby.

The remarkable thing about this case is the fact that the treatment made no impression whatever upon the gummatous degeneration of the testicles until the tension was relieved by the opening of the deep-lying hydrocele and the loosening up of the adhesions between the testicles and the obliterated portion of the tunica. Since that time I have repeated this experience twice, though in neither instance was the individual so profoundly poisoned constitutionally as in the case reported; but in both of them there was no response to the mercury or iodide until the tension was relieved. This is what I term conservative surgery applied to syphilitic testicles. If that could be obtained before the advent of the powerful remedy of Ehrlich, how much more readily could it be accomplished now.

### TUBERCULOUS TESTICLES

All over the world, every day, surgeons are removing testicles for tuberculosis. There was a time when I did it. I sometimes now resort to castration in these cases, but only under one of two conditions. The first is when the disease is confined to one testicle, and when, after a most careful examination of the mouth and throat, the lungs, the intestinal tract, the prostate, bladder, kidneys, the skin, and the bones, not finding any lesions that can be detected by our modern methods of diagnosis, I am satisfied beyond any reasonable doubt that I am dealing with the primary focus of the disease; without question, without hesitancy,

and without regret, I deprive that individual of his diseased testicle, exactly as I would deprive him of a diseased kidney under similar circumstances. If, however, I find any tuberculous lesion in any other organ, I know that I should be practicing unjustifiable surgery in removing that testicle — surgical work which I should condemn if done by myself, just as I should condemn it if done by any other person.

The other condition is that in which the disease is acute, rapid, and explosive; when caseous degeneration attacks the secretory structure and it rapidly breaks down, softens and destroys the surrounding tissues, and shows conclusively by its progress that no portion of it can be saved by any conservative measures. Even then it is always with regret that I operate, because I have a distinct doubt in my mind as to its efficiency as a probable preventive of a general infection; for, from experience, I know that in such cases the vas and the vesicle upon the same side are already the seat of the disease. Conservative surgery is usually applicable to tuberculous testicles. There is a principle not to be forgotten in these premises: tuberculosis is, of all the infective diseases, the one that most frequently gets well even under the most adverse circumstances.

The clinical experience which I obtained while working in the post-mortem room with Weichselbaum at the hospital *an der Wieden*, when a student, made a deep impression on me. It was a very rare thing for us to find a subject that was not either actively affected with tuberculosis in some one of its organs or showed its healed lesions. When, added to this, came the protest of my dead friend Chismore of San Francisco to my removing the testicles from a tuberculous subject in whom he and I were both interested, and which mutilation his veto prevented, and I later saw this individual get rid of what seemed to me to be a hopeless tuberculosis infection, I changed my views with relation to radical treatment of tuberculosis of the testicles, and became optimistic as to the possibility of the restoration of the functions of these organs, even when they were seemingly beyond possibility of repair. This was many years ago, and I have lived long enough to add a great many cases to this experience and to be thoroughly convinced that one should be very conservative about this species of surgery.

People are cured of tuberculosis of the lungs, and of the bones, and of the skin, and of the organs of the abdominal cavity — why should they not get rid of tuberculosis of the testicles? Even if the conditions are such that one is obliged to do a surgical operation upon such testicles, why should they be removed *in toto*? So long as any portion of the secreting structure of the testicle remains within the body, just so long will the function of copulation be preserved to the individual. This is not a matter of indifference. When one has tuberculosis of the testicles, the removal of this organ protects society from the propagation of a race that only keeps up tuberculosis by its weakness.

But I will direct your attention to the fact that we are not acting for the race. Our services are sought and demanded by the individual, and it is our business as surgeons to act for the welfare of this individual who is looking to us for the exercise of our skill; if we can conserve this individual in such a condition that the genital function is preserved, along with the other functions of his body, we have, in my opinion, exercised the highest attribute of medical and surgical skill. If we can only preserve the ability in that individual to copulate, even if we have to sacrifice his power to become a progenitor, we have still accomplished a work that is an excellent one for the individual; because it is a well-known belief that the testicle, like all other glandular organs, has an internal secretion which is of value in conserving the balance between the different animal functions.

Tuberculosis of the testicles commonly commences in the epididymis and is frequently confined thereto. It is quite easy to remove the epididymis and preserve all of the testicles to which an undiseased vas may be coupled up; or the epididymis and its diseased vas may be removed and the healthy testicular substance still be retained; or the epididymis

and the diseased portion of the vas and the portion of the testicle which is tuberculous may be resected, and an attempt made to preserve the healthy or apparently healthy substance of the remaining portion of the testicle, if a sufficient blood-vessel supply can be retained for this purpose.

I assure you it is rather wonderful what one can do with such a testicle. I have now a patient who had both epididymi removed in Chicago some five years ago; neither gland was tuberculous, and he presented then no tubercular foci in the prostate, or bladder. This man was married at the time and had a child; he has continued in happy marital relations ever since, and both he and his wife state that these relations are regular and entirely satisfactory; but there have been no more children. He ejaculates a fluid that has the appearance and odor of normal semen, and contains abundant leceithin granules, but no spermatozoa. He states that the sexual feeling is as strong as it ever was and that the orgasms are perfect. I have observed several cases of this kind, and quote this one simply because all of the circumstances attendant upon it are so fresh in my mind. This man now has tuberculosis of both kidneys, but both testicles appear healthy. The bladder is not yet diseased, though there is some irritation about the mouths of both ureters, and the catheterized urine from each kidney contains tubercle bacilli. Such being the case, what would have been the use of depriving this man of his testicles and thus preventing the five years of happy life he has had? He is not the subject of tuberculosis of the kidneys because his testicles were not removed five years ago, but because he has the soil upon which the tubercle bacillus thrives, and his kidneys have become infected for this reason alone.

I have another case that is a still more remarkable proof of the value of conservative surgery as applied to tuberculous testicles. One of my patients, a man of 48 years of age, has had tuberculosis of the lungs at intervals since 1901, with intervening periods when he was apparently in perfect health, with the lesions of the lungs cicatrized. In January, 1906, he was attacked suddenly by an acute tuberculous infection of the left epididymis. Within a week after the appearance of the first nodule the gland became painful, enlarged rapidly, and a few days thereafter was adherent to the skin, broke down, and discharged itself through multiple sinuses; the scrotum became red and a destructive ulceration rapidly took place in it. On January 25th I removed the testicle, almost all of the scrotum on the left side, and the vas as far as it was diseased, which was within three ccm. of the seminal vesicle. The vesicle itself did not feel diseased, either through the rectum or the abdominal wound. No attempt was made to close the wound; it was left open, dressed with iodoform and balsam of Peru, and exposed to the X-ray every other day for two weeks. The wound healed in a month.

In January, 1907, the right testicle was attacked; this process was very much slower. From the beginning the entire epididymis was affected; it became large, swollen, and hard and within two months formed adhesions to the scrotum, from which adhesions multiple sinuses communicated with the epididymis. There was no suppuration, but there was a sticky discharge, clear and thin. There was very great pain, apparently neuralgic, at the inguinal ring. On March 15th, for relief I removed the entire epididymis and the vas which was also diseased to within a few centimeters of the seminal vesicle. There was no evidence of any bladder irritation and nothing could be palpated in the vesicle or the prostate on this side. After the removal of the epididymis it was found that about one-fourth of the testicle at its upper extremity was the seat of a tuberculous gumma that had not yet broken down. This was resected carefully, the tunica albuginea being preserved, as it was not adherent to the gumma and was not involved in the growth. The wound was left open and packed with iodoform gauze.

Early in April a necrosis of a portion of the adjoining tissue was noticed, and this part was resected on April 7th; this left a little less than one-half of the testicle, hollowed out and apparently very unpromising. The

edges of the tunica albuginea were brought together over this hollow and a minute strip of rubber tissue drain carried down inside of it. There was no suppuration following, but the wound was very slow in healing. The X-ray seemed to stimulate the infected wound upon the left side to speedy healing, but it seemed to retard the healing of the wound on the right side. The wound was dressed with iodoform and balsam of Peru, and tuberculin was administered every four or five days, in ascending doses of 1–100,000 mgm., but it took about six months before a perfect cicatrix was obtained. Attacks of intra-abdominal neuralgia at the internal ring continued at intervals for nearly two years; they were extremely painful, and resembled attacks of appendiceal or renal colic. They rarely lasted more than a half hour, and always left him completely exhausted. There was never any direct trouble with the bowels or with his digestive organs, so I could not bring myself to believe that the attacks were appendiceal, more particularly as there was never any pain over the appendix upon pressure. Ureteral catheterization and X-ray pictures of both kidneys showed no disease of the ureters or kidneys. At the end of the second year the attacks disappeared and have never recurred since. These were probably due to inflammatory adhesions about the internal ring, for they existed after the disease appeared in the epididymis and before the operation, and he was free from them for a month or two after the operation; then, later, when these adhesions had had time to form again, they recurred with great violence.

Remember, this man has only one-half of one testicle left, but to the sense of touch and to the eye it is a very good one-half, quite as large as a whole testicle is in many men. But the testicle has no vas attached to it. Within six months after the last operation my patient was looking for a woman. He stated that his sexual desire was intense and his gratification was perfect. In 1909 he married, and is still married to the same woman. His tuberculosis of the lungs has caused him to spend his time in the mountains of Mexico or New Mexico, for while there he has no active symptoms. He married because he knew, from two years' experience following the operation, that he could live with a woman in sexual relations. Both he and his wife state that they have intercourse several times a week, and that he has perfect orgasms, but that there are no ejaculations.

Before closing I want to present an illustration of what may be accomplished toward the saving of a testicle that has been fractured or ruptured by direct violence and which would appear to be irretrievably injured, requiring removal.

On May 16, 1912, there was admitted to the Santa Fe Hospital, in Los Angeles, a man of 34, whose occupation was that of a brakeman. This man's left testicle had been injured in a railroad accident on April 5th. Immediately after the accident the left side of the scrotum began to swell and he suffered great pain; there was much discoloration and ultimately great distention on that side. He was confined to his bed in his home in a country town for three weeks, When I first saw him the testicle was about three times the normal size, and the case had been mistaken for one of traumatic epididymitis. Upon my examination on May 22d I saw that the case was one of hæmatocele; and on May 23d, with the suspicion that, following the injury, a sarcomatous change had occurred, I cut down upon the testicle and found the tunica vaginalis filled with half-organized blood clots. There was a large longitudinal tear in the tunica albuginea, through which extruded a mass of necrosed secretory structure, which included a little more than one-half of the glandular tissue of the organ; part of this tissue was dead, and more of it was on the border line between life and death.

I determined to make the effort to save the remaining healthy tissue, and, encouraged by my assistants, resected all of the diseased tissue, hollowing out the structures underneath the tunica albuginea so as to be able to close the wound. The blood-vessel supply was unimpaired, and the tunica albuginea was not necrosed, with the exception of a very small margin on the edges of the wound,

which was resected along with the dead testicular substance. The edges of the wound were then brought together by very fine sutures of No. o catgut threaded into an eye-needle, and the tunica vaginalis resected and a new bed hollowed out for the testicle in the scrotum. The wound in the scrotum was closed, with drainage. The testicles were placed upon a shelf and surrounded by ice caps, which were kept in place for four days. There was no swelling, or inflammation following operation; the drainage was removed on the second day, he was out of doors on the seventh day, and left the hospital in two weeks, entirely well. This testicle to-day has the feel and is approximately the size of a normal testicle, and to all indications and purposes it is so.

It is perfectly possible that, after long months of suffering, the necrosed portions of this testicle would have separated from the healthy ones, and the result would have been the same — that is, the conservation of the healthy portion by nature; but the chances are much larger that if this had been left to nature the testicle would ultimately have been lost.

These cases are cited merely as examples of what can be done toward conservation in cases of disease or injury of the testicles. I could fill a book with the histories of cases of tuberculosis of the testicles, apparently hopelessly diseased, which have ultimately been restored to good functional use by conservative medical and surgical treatment. The case of syphilitic testicles in which conservative treatment of a surgical nature can be practiced must necessarily be very few. The cases of injury of the testicle in which an effort may be made or should be made to save the organ are not very many. but if both sets of blood-vessels leading to the testicle have not been destroyed, it is well worth while to make the effort, and it is often successful.

I am very well convinced that if Hagner's operation were more often resorted to in cases of gonorrhœal epididymitis, there would not be so many barren men as there are at the present time.

# SOME USES OF FAT IN SURGERY[1]

By J. F. BINNIE, A. M., C. M., F. A. C. S., Kansas City, Missouri

FAT has an evil repute, partly because of the inconvenience inseparable from great obesity and partly because wounds through great masses of fat do not heal particularly well, and yet, as we will see, this abused tissue fulfils very useful functions. The most widespread tissue in the body is connective tissue, which serves many functions: it binds various structures together, it secretes various salts and so converts itself into bone, it forms cartilage, and it absorbs oil into its cells until each cell is a small bag of oil and constitutes fat — an extremely light and elastic packing and padding material, which can be reabsorbed and used as food when occasion arises.

Tumors of pure fat (lipomata) are common, and fat may increase locally in tumor fashion, as witness the increase in the omental fat contents of old irreducible herniæ.

In spite of its reputation as a tissue of poor resisting power, fat is well suited for transplantation. In many instances it is undoubtedly the connective-tissue basis of the fat which is of value in the transplant, but in other instances other varieties of connective tissue would be valueless compared to that which is infiltrated with oil.

I. Hæmostasis is often difficult to attain in wounds of the liver and like parenchymatous and vascular organs. Tamponade with foreign material, while useful, has obvious drawbacks. Sutures are liable to tear loose in the friable tissues. Such wounds may be treated by omental grafts in one of two fashions.

(*a*) Choose a fragment of omentum of suitable size and volume, ligate it, and divide it distal to the ligature. The fragment must be more than sufficient to completely fill the wound in the liver. Plug the liver wound with the omental mass in such a fashion that the edges of the wound are overlapped by the omentum. Introduce sutures so that they pass in through overlapping omentum, through liver substance into the depth of the wound, and through the omental plug contained in the wound, to emerge on the opposite side of the wound after passing from within outward through liver substance and overlapping omentum. By perforating the overlapping omentum and the plug the sutures when being tied are less liable to cut through the liver substance. Loewy[1] finds that the omental plug becomes adherent to the raw surface of the liver wound, prevents hæmorrhage, and ultimately becomes converted into fibrous tissue. The exposed part of the plug does *not* become adherent to the intact peritoneum.

(*b*) Boljarski[2] and Stucky[3] have pressed free flaps of omentum into hepatic wounds as plugs, or have spread and pressed such flaps as plasters over raw surfaces such as may be left after a difficult cholecystectomy. If the flap is pressed into its hepatic bed it adheres so well that sutures are unnecessary. In a case reported by Stucky cystectomy was followed by free venous bleeding. Tampons, sutures, etc., failed to stop the bleeding. As a last resort a free flap of omentum was pressed against the raw surface; it adhered and stopped the hæmorrhage. The patient died at the end of three days. The autopsy showed the graft absolutely adherent to the raw surface of the liver but *not* to the peritoneal surface.

A number of hepatic wounds have been successfully treated by omental tamponade. In a case of crushing injury, W. J. Frick (personal communication) found many lacerated wounds of the kidney which bled freely. Other methods of hæmostasis failing, he plugged the wounds with perirenal fat held in place by a suture and secured good results. Mayo, Bastianelli, and others reinforce the suture, closing wounds of the renal pelvis with flaps of perirenal fat, and find them of much value.

After myomectomy the sutured uterine wound may be covered with a plaster con-

[1] Rev. de gynéc. et de chir. abdom., x, 821.
[2] Arch. f. klin. Chir., xciii, 2.
[3] Arch. f. klin. Chir., xcix, 384.

[1] Read before the Clinical Congress of Surgeons of North America, Chicago, November, 1913.

sisting of a free flap of omentum held in place by a few stitches (Mayo). This graft aids in preventing any oozing of blood. The omental grafts placed over intestinal wounds to prevent leakage of intestinal contents are methods of peritonealization and depend for their value entirely on their fibrous tissue constituents and peritoneal covering and not at all on their fat contents; in fact, a very fat omentum, while desirable as a plug for liver wounds, is entirely unsuited to act as a plaster over an intestinal wound. The same is true for a procedure devised by the writer, where he tied a free flap of omentum round the pylorus to permanently obstruct it after gastro-enterostomy had been performed.

II. Traumatic epilepsy is sometimes due to fibrous tissue changes in the pia and to adhesions between the meninges and their coverings (skull, scalp). The usual operative treatment of traumatic epilepsy consists essentially in the removal or elevation of any depressed bone, in the excision of any irritating scar-tissue or of any cystic formations, etc. Endeavors have been made to prevent the formation or reformation of adhesions by covering the cerebral or meningeal wounds with metallic foil, celluloid plates, rubber tissue, Cargile's membrane (prepared peritoneum), egg membrane, hernial sac (fresh or prepared), fascia lata, etc. A successful ward politician of Missouri was in the habit of saying with regard to factions in his own party, "If you can't bate 'em, jine 'em;" so with regard to cerebral adhesions one may say, "If you cannot prevent their formation, make them harmless."

Rehn[1] (in Lexer's Clinic) found that 45 days after a cranial defect had been filled with fat, a clear and distinct basal connective-tissue sheet spanning the dural defect had developed in the transplant. This sheet was elastic enough to permit of expansion and was in no way like the dense connective tissue usually present in cranial defects. In Rehn's experiments the fat flap was spread on the pia, and naturally adhesions could not be avoided, but they were never dense and extended; they consisted of delicate, easily separated fibers of connective tissue except when infection took place, when they were both dense and spread out. The following case may be of interest:

L. A., aged 24; stationary engineer. Admitted Kansas City General Hospital September 26, 1912. On May 13, 1907, a steam pipe, exploding, drove one end of the pipe into patient's right parietal region. He was unconscious for 24 hours. Operation was performed, a number of fragments of bone being removed as well as some lacerated brain substance. When consciousness was recovered there was total paralysis of the left arm and partial paralysis of the left leg. In three months the leg had practically recovered completely; the arm was much improved and continued improving for three years, until now there is merely a partial loss of sensation in the fingers, sufficient, however, to interfere with work. When the patient bends down and rises again there is a painful sense of tearing at the site of injury and there is giddiness. There have never been any convulsions.

Three years after the injury the hiatus in the skull was exposed by operation, scar tissue divided, and the wound closed. As soon as healing was complete the old symptoms recurred. In the right posterior parietal region there is a hiatus in the bone about 1 x 1½ inches in size. When the patient is lying down there is no depression of the scar, but when sitting up the depression is marked. Sensation in left hand is so faulty he can rarely tell the position of the middle finger, and that of the other fingers only with hesitation.

September 28, 1912, Reflection of scalp; excision of scar tissue from hiatus in skull; implantation of enough fat (from the abdominal wall) to completely fill defect. Closure of scalp wound. Healing per primam.

February 4, 1913. The patient is at work. He feels and looks well; can bend to floor and get up again without discomfort. There is now a depression at the hiatus, although two months after operation absence of depression was noted. In March, 1913, the patient reported himself well.

It has appeared to the writer that where a cavity is left in the brain after removal of a tumor or evacuation of a cyst, if the cavity does not quickly disappear through cerebral expansion possibly a plug of fat might be a suitable tampon. The specific gravity of fat is somewhat less than that of cerebrospinal fluid. The writer has had only one opportunity to try the method, and that was in a case of internal hydrocephalus following an old and severe trauma where, during operation, the ventricle was opened under the impression it was a cyst. Failure was a foregone conclusion.

[1] Arch. f. klin. Chir., ci, Heft 4.

III. Many otherwise beautiful faces are deformed by the presence of depressed scars adherent to underlying bone. Sometimes such scars may be neatly excised with gratifying results, but sometimes such treatment is unsuitable or fails. Subcutaneous division of the adhesion between the skin and the bone may do good, but it does not replace the tissues the loss of which was the cause of the depression. If through a suitable incision the adhesions are thoroughly divided, and if then (after hæmostasis is attained by pressure) a suitable mass of fat is gently insinuated through the cut to fill up the depressed area, an ideal result may be obtained. It is best to obtain the fat for transplantation from the patient himself (autoplasty), as homoplasty (i.e., transplantation from another individual of the same species) is not quite so successful and heteroplasty (transplantation from a different species) commonly fails.

IV. After excising the breast for non-malignant disease it is occasionally of considerable importance to reproduce an æsthetic swelling at the site of the mamma. Czerny had occasion to remove one breast and a lipoma from the back of the same patient. Instead of discarding the lipoma he planted it in the bed left by the mamectomy and obtained a good result.

Judd had removed a breast from a woman for non-malignant disease, and almost at the same time he operated on a large irreducible umbilical hernia. From the hernia he obtained a suitable mass of omentum and implanted it at the site of the mamectomy. The graft lived and the cosmetic result was gratifying.

Klapp, in two cases after excision of the breast for benign neoplasm, implanted masses of fat obtained from the patient's own thigh. From one of these patients a morsel of the implant was excised after the lapse of four months and found to consist of living normal fat with wide connective-tissue septa. Hertzler has had success similar to that of Klapp.

V. When disease has been chiseled out of a bone, recovery is very slow unless the cavity left in the bone is obliterated by the art of the surgeon. The aseptic blood clot, iodoformized decalcified bone chips, iodoform starch, iodoform wax, and various other plugs have all been used with greater or less success. Numerous plastic operations, by which pedunculated flaps of bone and skin have been transferred to and fixed in the cavity, have all given a measure of success. Both Chaput and Makkas independently published in 1904 methods by which bone cavities might be obliterated by the implantation of non-pedunculated masses of fat.

Krabbel,[1] from a study of ten cases in Garre's Clinic, comes to the following conclusions:

1. In chronic osteomyelitis without fistula, implantation of fat has made good. If fistulæ are present implantation is contra-indicated.

2. Sharply delimited, easily accessible tuberculous foci are suitable for fat implantation, even when they are situated near the articular ends of the bone. Diffuse tuberculous lesions of bone and widespread disease of the soft parts may only be plugged (with fat) after the most careful and accurate removal of *all* the disease. If healing per primam does not ensue promptly, or if a fistula forms, the implanted fat must be removed at once, because of the grave danger of tuberculosis developing in the implant.

Chaput in 1913 reported to the Societé de Chirurgie of Paris the case of a woman from whom he had removed an osteomyelitic focus eight years previously and in whom he had plugged the bone cavity with a free flap of fat. After eight years of good health a new focus of disease developed near the site of the old lesion, and the necessary operation permitted demonstration of the satisfactory healing in the bone of the transplant of fat made eight years previously.

Makkas' experiments show that it is almost always possible to close aseptic bone cavities with free flaps of fat, even when these cavities communicate with joints. The fat is sometimes changed into connective tissue; sometimes it persists, but the plug is always (Makkas' experiments) surrounded by a new-formed layer of compact bone derived from the walls of the cavity. In one of Makkas'

[1] Brun's Beitr., lxxxv, 403.

three successful cases in man, the cavity was infected with staphylococci.

In extensive chronic osteomyelitis of the humerus with fistula, M. P. Lawrowa[1] reports healing in about three months, although there was "partial wound suppuration."

The writer has made use of fat to fill the cavity left by removal of a metacarpal tuberculous focus and was gratified with the result.

In any operation where an infective focus is excised from a bone and the resulting cavity is to be plugged with any suitable material, it is important to operate in a well-ordered, rather formal, systematized manner. Operation may be carried out somewhat as follows: (1) Remove all evidently diseased or infected tissues and sterilize the wound with pure carbolic acid, neutralized afterwards with alcohol (Harrington's solution or pure formalin solution may be used). Pack the wound with gauze. (2) Let the surgeon and assistant put on clean gloves. Prepare the region of the wound as if for a new operation. Using freshly sterilized instruments, remove the pack from the wound and with chisel or burr cut away a layer of bone from the walls of the osseous cavity. Once more chemically sterilize the cavity and wash away the chemical with salt solution. Pack the cavity. Once more change gloves and instruments. (3) Obtain a mass of fat of suitable size, preferably from the patient himself. Do not touch the fat transplant with the fingers, but lift it in forceps with the least possible trauma. Remove the pack from the bone cavity. Completely fill the bone cavity with the fat transplant. Close the wound without drainage. Only by some such systematic procedure can asepsis be reasonably assured.

VI. *Arthroplasty.* When a bony ankylosis has been divided and the articular ends of the affected bones have been properly modeled, their reunion may be prevented and a new joint may be obtained by interposing living soft tissues between them. Murphy has done very much to develop arthroplasty. In his work (and the writer pleads guilty to the same fault, if it is a fault) he has been careful to use *pedunculated* flaps of fat. To use flaps provided with peduncles complicates the operation considerably, and it seems to the writer that once the flaps are twisted into position the peduncles are of very doubtful value. If free, i.e., non-pedunculated, flaps of fat and fascia thrive in other situations after transplantation, why not when used in arthroplasty? Röpke has been successful in using free transplants of fat, even as large as the hand, in arthroplasty.

VII. After tenorrhaphy or neurorrhaphy it is very important to prevent the line of union from becoming closely adherent to neighboring structures. There is no better prophylactic measure than wrapping a free or pedunculated flap of fat around the part to be protected.

VIII. In pulmonary tuberculosis and in bronchiectasis various operations have been devised to put the lung at rest and to cause any pulmonary cavities to collapse. Artificial pneumothorax or the filling of the pleural cavity with nitrogen, Friedrich's operation of excision of the chest wall, Sauerbruch's and Wilm's operation of extensive rib section causing collapse of the chest wall,—all these are endeavors to attain the same end. Tuffier[2] has successfully grafted voluminous masses of fat between the mobilized parietal pleura and the ribs in bronchiectasis. Paraffin wax of low melting point has been used instead of wax. The same method may be used to close suppurating and tuberculous pulmonary cavities.

[1] Ztschr. f. Chir., 1913, No. 30.

[2] Internat. Med. Cong., Lond., 1913

# THE RELATION OF THE DUCTLESS GLANDS TO THE WORK OF THE SURGEON[1]

By ROSWELL PARK, M. D., LL. D., Buffalo
Professor of Surgery, Medical Department, University of Buffalo; Chief Surgeon to the Buffalo General Hospital; Honorary Professor of Surgery, Army Medical School

DURING recent years I have realized ever more forcibly the growing importance of the subject selected for this address, and therefore I make no apology for its introduction upon this occasion. Those audiences before which I have already discussed some of its phases and aspects have been so small compared with this that a reiteration of presentation of certain of its features previously made calls for none. But before this large and unusual audience, assembled from all parts of our country, it seems desirable to first call attention to certain generalizations essential to a more ready comprehension of that which may follow.

The internal secretions, so often spoken of as hormones, exercise an apparently controlling influence, hitherto but crudely appreciated, on many of the organs and functions, and this not alone on the ordinary body functions, but on the nutrition and regulation of individual organs and their particular activities, even to the extent of becoming responsible for the development of certain mental traits or personal characteristics which may make or mar the individual, and may thus affect both his physical and intellectual welfare.

For example, dwarfing or gigantism, each of which seems due to perverted activity of one or more of the ductless glands, naturally affects the social and school life of a growing child, and to such an extent that when conspicuous deformity results the entire course of life may be affected to an extent which is appalling. Such defects, for instance, as are to be noted in a rachitic child may, by making him an object of ridicule among his playmates, entirely change his nature and disposition, and thus change his temperament and his life work. Such consequences are by no means so indirect as may at first appear. The early effects of hypo- and hyperthyroidism, thymism or pituitarism need only to be better known in order to have this significance better appreciated. So, too, with regard to several of the mental derangements which in time past have brought the young and growing child, the adolescent, or even the adult to the operating table; we may now realize that in their inception, at least, they constitute expressions of over- or underactivity which, had they been recognized early, might have been prevented or at least avoided by a suitable opo- or organotherapy.

Conditions of this sort, then, have led to an ever-strengthening conviction on my part that, even as surgeons, we need to apply the most exact attainable knowledge of the ductless glands and their significance (so soon, that is, as the physiologists furnish it) to our orthopedic and our numerous other cases of arrested or perverted development. And if that most excellent definition of the surgeon be true, which some author to me unknown has perpetrated, namely, that a surgeon is "a physician who knows how to use his hands," then it doubly devolves on us to cultivate this field of research.

So much, then, by way of introduction.

And what, then, are these most important parts of the body that play such a mysterious yet imperious rôle in influencing development and welfare? Our literature is now rich in essays or monographs dealing with the internal secretions, and the recent large works of Biedl and of Falta, superseding to some extent the memorable monograph of Sajous, are monuments to the industry and research of their authors. Continental authorities, German especially, seem to have contributed much more to this subject than have our English colleagues, and it is interesting if not significant that both the recent authors just mentioned are members of the Vienna Faculty. There should, however, be mentioned

[1] Read before the Clinical Congress of Surgeons of North America, Chicago, November, 1913.

along with these books the recent excellent work of Gilford.[1]

Take, for instance, the overproduction of adipose tissue — not alone that form which constitutes general adiposis (often dolorosa), but the earlier forms, which in many respects more or less resemble cretinism. These deposits are serious impediments to the welfare of patients, young or old, and produce difficulties well-nigh insuperable in certain surgical cases. To the perverted activity of which ductless gland is it due — pituitary, thyroid, or genital? In relatively few cases can we as yet decide. Still less can we assign to any one of these glands its exact rôle in this complicated and generalized fat deposition.

Still less, too, are we able to fix responsibility on these small organs in cases of retarded mental development, occurring as they do at times in children dwarfed in stature, or again in those of precocious growth; equally uncertain are the reversed features of mental precocity in those of diminished skeletal growth. Imbecility, then, with or without manifestations of cretinism, is, let us say, a frequent result of the perverted development which is ascribed to altered and abnormal hormones.

While surgical operations may then be requisite to meet particular indications, it would be a mistake to subject every microcephalic child to a craniectomy. Such mistakes I have myself made in time past, having operated, as have others, on numerous children belonging to this class with only a modicum of success. The furor for this kind of surgery of the cranium has passed; but a most valuable lesson has been impressed, namely, that we should estimate general and especially hormonic conditions much more accurately before resorting to manualization. The principal argument in favor of such indiscriminate operative work would rest with those advanced thinkers who in such cases see in euthanasia a boon to the race in general and an indirect benevolence to those vitally and parentally concerned.

According, then, to the teleological views of the individual will such efforts as these be favorably or unfavorably regarded. If operative surgery is to be the aim and end of professional endeavor, then the attempt to restrict rather than expand its field will not meet with approbation; if, on the other hand, an operation be regarded as but a means to an end, then every conscientious practitioner will welcome the effort to attain that end by some less hazardous, more promising, and safer course, especially if it be founded on a more accurate apperception of fundamental conditions.

The doctrine, not the theory, of internal secretions was not yet born when, in 1889, Brown Séquard reported his first memorable experiments in a communication to the Société de Biologie. The theory of these secretions was perhaps a hundred years older, and was the outcome of notions according to the old humeral pathology that the blood stream contains abnormal products from various organs; it was the outcome of an analysis of the changes ensuing upon castration, followed by the transplantation experiments of Johannes Müller, who recognized secretory activity in cells and in the membranes and glands composed of them, whose products exercise an internal rather than external and visible influence. Berthold, in 1849, had already proved this by his experiments, though his deductions were not recognized by such investigators as R. Wagner. Claude Bernard was probably the first to accept the doctrine and to use the term "internal secretion."

Of these hormones some are produced from membranes, e.g., in digestion; others are formed within the ductless glands, whose products apparently enter the venous capillaries. To all of these is given the collective name *hormones*, implying thereby their property of acting as stimuli to some other organ or collection of cells different from those which produce them. Their recognition has served to better explain many obscure processes, while at the same time it has complicated our proper appreciation of the multiple and reciprocal activities of various parts of our bodies. Nearly all if not all of the organs and secreting membranes of the body act in

[1] Gilford, "The Disorders of Post-Natal Growth and Development." 1911, London.

this way, i.e., they affect the function of other organs or membranes, although in our present state of knowledge the true blood-forming or blood-elaborating organs (spleen, marrow, lymph-nodes, and hæmic glands) are excluded from this category.

It will appear, further along, that this doctrine relieves the autonomic (or vegetative) or sympathetic nerve-system of some portion, at least, of the work which we have hitherto credited to the "trophic" nerves. Strictly, then, the list of ductless glands should be thus made up:

Hypophysis {Anterior, posterior;
Epiphysis or pineal gland;
Thyroid;
Parathyroids;
Thymus;
Adrenals (medullary portion), and the entire
Chromaffin system:
Pancreas (intertubular cell groups, islands);
Genital glands {ovaries, testes.

To these may be added

Breasts;
Tonsils;
Carotid and Luschka's glands. These will receive but casual if any mention in the present consideration, since our knowledge of their utilities or purposes is yet too vague. This may also be said of the pineal body.

The *embryonic origin* of the ductless glands is of importance, because some of them are of distinctly epi- or hypoblastic origin, others of mesoblastic. The anterior hypophysis is of the former, i.e., ectodermal, while the posterior portion is neurectodermal. The thyroid is entodermal, being developed from the anterior wall of the craniopharyngeal canal and the pharyngeal clefts on either side. It is of interest that both the anterior hypophysis and the thyroid were at one time, and originally, active glands emptying their secretions into the primitive alimentary canal.

The thymus is of essentially the same origin as the thyroid, hence perhaps the peculiar relations between the two. The islands of the pancreas, which interest us in this connection, are also entodermal, developed from pouches formed around its ducts.

The adrenals are of mesoblastic origin, developing from the cœlomic epithelium. The genital glands also are of the same origin. There is, moreover, a striking resemblance in many respects between the cells of the adrenal cortex and those of the interstitial genital glands. The chromaffin tissue, or so much of it as is not included in the adrenals, probably is of ectodermal origin.

Thus it will be seen that all three layers of the developing embryo are concerned in the formation of one or more of these bodies, and that both the genital glands and adrenals are developed from the epithelium of the cœlom.

Here and later it is desirable to emphasize the reciprocal relations obtaining between those organs which have so much to do with the development of the skeleton, and to note how any disturbance of these relations may produce skeletal defects. Even deformities which seem at first trifling may have far reaching consequences from such distortions of the upper part of the body as may indirectly affect nutrition. Quite recently Preiser has described at length the "static joint disease" which leads to faulty attitude, produces inertia, and indirectly affects the life history of the individual. One must not forget, however, that changes from the archetype which were produced by man's assumption of the upright position have brought about many indirect disturbances, especially about the pelvic girdle. The correct architecture of the bony skeleton may be notably perverted in this way, since it has permitted so many visceral ptoses, as well as changes in circulation of the abdominal viscera, that the nutrition of a number, if not all, of the ductless glands has been affected.

A very imperfect and partial list of conditions evidently due to hormonic disturbance would at least include the following:

Acromegaly;
Hydrocephalus internus, resulting from obstructed discharge of the posterior pituitary into the cerebrospinal drain;
Graves' disease, with or without persistent thymus, and even hibernation;

Myxœdema and cretinism;
Tetany;
Thymic asthma and the status lymphaticus;
Rickets;
Achondroplasia;
Obesity;
Addison's disease;
Sexual changes, including amenorrhœa, eunuchism, etc.;
Mental defects of various types — infantilism, mongolism, and the other extreme, mental precocity;[1]
Skin dystrophies, including dryness or the reverse, i.e., excessive perspiration, loss of hair, or other changes;
Neurasthenia of certain types, especially that with moist, clammy skin, bright, restless eyes, glossy hair, exaggerated reflexes, muscle tremors, abnormal hunger, diarrhœa, menorrhagia, insomnia, exaltation of special senses, hot flashes, frequent pulse, etc.

Here the benefit from suitably directed organotherapy is sometimes striking. Thus we are seeing daily, and all around us, instances of perversion of the internal secretions, yet without knowing just how to distribute their symptoms or assign to each ductless gland its part or share in the guilt; we are, therefore, almost powerless to help. Hence it is that we have so often to resort to the therapeutic test, namely, to administer first one and then another of the extracts until we determine which is indicated.

Another most important feature is the evident antagonisms which prevail between certain of these bodies, now one, now another acting as regulator or governor of the production of some other gland; thus, between the thyroid and the genital glands marked relationship is evident, since menstruation may be restored and pregnancy possibly occur after myxœdema and cretinism have apparently been cured by thyroid extract.

Many of the unpleasant features of the menopause are apparently due to hyperthyroidism and may be relieved by administration of ovarian or corpus luteum extract. Again, according to Kidd, the pineal body furnishes a hormone which has marked inhibitory effect on the genital glands. Inasmuch, however, as it undergoes only partial involution at puberty, it may also have some other effect. Little is known of the pineal body, but we may be sure that it has at least some more tangible function than being, as the ancients supposed, the seat of the soul.

Between the thyroid and the pancreas, too, there seem very intimate relations, as also between the pancreas and the parathyroids with the hypophysis and the entire chromaffin system.

The hormones fall into two groups, the *upbuilding* and the *destructive*, while each group exerts an inhibitive effect upon the other. Overgrowth, i.e., gigantism, implies decreased or inhibited disassimilation. Normal growth, i.e., activity, implies an equilibrium maintained. Complicating all these growth features appears the as yet undetermined influence of the nervous system. What difference will later be made in our notions regarding the trophic nerves remains to be seen.

Hormones are by no means necessarily complex chemical bodies; from adrenalin (methylamino alcohol of pyrocate) as one of the most complex, we have simple carbon dioxide at the other extreme.

From surgical experiences much has been learned, e.g., from cachexia strumipriva and ovaripriva and from post-operative tetany; while experimentation has proved invaluable, most of our practical knowledge having come from these two sources. Were it not for a study of the results of removal of the hypophysis and other organs mentioned above, our acquaintance with this subject would be very limited.

Internal secretory organs labor under the disadvantage that they can only expel their products into the blood, since they have no duct. Hence if their secretions become in any way abnormal the blood nevertheless carries them everywhere, and they must either be neutralized or antidoted or the body will

[1] Parenthetically it might be emphasized here that when dealing with cases of this character there is greatest need for combining with whatever treatment may be selected a suitable environment. This is fully as essential as therapy when dealing with defective children. Indeed, in many instances the parents need treatment (educational) fully as much as do their children, their lack of discipline being a conspicuous feature. Isolation or separation of the child from the over-anxious and indulgent mother, preferably in a suitable institution, is of paramount importance.

suffer. The liver is our best illustration of a secretory organ antidoting its own output; urea is the main end-product of albumin metabolism, and by means of it the liver regulates itself, altering it to the desirable extent. Cretinism on one hand and exophthalmic goiter on the other furnish illustrations of a ductless gland which has not the capability of regulating its own production. A change, especially a sudden one, in the number of ions of the metals of the alkaline earths (K, Na, Ca, and Mg) causes immediate and notable effects on function. Muscular irritability, e.g., depends largely on the calcium salts, and their presence or absence is the factor upon which depends muscle repose or constant rhythmic contraction. It is secretin, e.g., also, which determines in a way the closure or opening of the pylorus. Such a surgical condition then as pyloric spasm may have much to do with the internal secretion, and hence the value of calcium salts in surgical therapeutics. We may replace a hormone but not a real secretion.

Having spoken of antagonisms, let us mention also similarities. As between the thyroid and the anterior pituitary let us remember that phylogenetically both were once glands with an external secretion, and that they have morphological similarities. Animals deprived of either behave in much the same way; they remain small, evince similar vegetative symptoms, and become ill in much the same way. In acromegalics the thymus often enlarges, just as when the thyroids are overactive. In cretins we often find degeneration of the hypophysis similar to that of the thyroid, and when pluriglandular symptoms appear they are nearly alike.

Between the thyroid and pancreatic islands similarity obtains in that, in typical myxœdema, carbohydrate assimilation is increased and glycosuria occurs, while after disease of the islands the same takes place; in fact, both these conditions prevail after extirpation of either part.

So far as the pancreas and the adrenals are concerned, in that form of chronic alcoholism where the pancreas is involved as well as the liver, we find pigmentation of the skin much resembling that of Addison's disease, and even though the diabetes due to involvement of the pancreas may later subside, the bronzing due to adrenal cirrhosis does not disappear.

There are two methods of approaching or presenting the subject to which your attention is invited:

First, by cataloguing the organs and their functions, and making the attempt to list the morbid conditions due to their disturbance. This may be called the anatomico-physiological method.

Second, by cataloguing the various general conditions under consideration and interrogating the various organs with a view to fixing the blame. This may be considered the clinical method.

Each of these has its advantages and its difficulties, among them this especially — that each is characterized by a most confusing overlapping of facts due to the overlapping of functions. Thus, in the matter of skeletal growth: this apparently is regulated in the very young by the pituitary and the thymus, but that peculiar dystrophia adiposo-genitalis which is the principal feature of hypopituitarism is seen also in hypopinealism and hypothymism.

We will begin with the first method, selecting the more important organs and first discussing them separately.

### THE HYPOPHYSIS

As a whole, this is a persistent organ and therefore must have throughout life a continued function. Extracts of the whole gland increase blood pressure, cause uterine contraction, increase peristalsis, lower carbohydrate assimilation, and have a mydriatic effect. Used to excess they cause emaciation, degeneration of the liver, and increased metabolism. Extirpation produces in animals a peculiar cachexia, reduced pulse rate and respiration, fibrillary tremors, and death in apathy and coma.

The hypophysis probably undergoes an epochal overgrowth at puberty. This may have causative results, since it might account for the transient glycosuria seen at that time

and for the marked changes which occur in the sex organs. Conditions simulating hibernation in man often yield to pituitary extract.

Symptoms of impaired activity include local œdemas of the skin and superficial fat anywhere about the body, face, arms, hands, etc., as well as a dry, harsh condition of the skin, with bristly hair which is easily and early lost. The external appearances are very similar to those of myxœdema, while temperature becomes subnormal. Indications of impairment in the anterior lobe include retardation of skeletal growth with excess of fat, delayed ossification as shown by skiagrams, mental dullness and irritability, with transient glycosuria.

Indications of impairment of the posterior lobe include a high tolerance of sugar with resulting though indirect adiposity, polyuria, sexual impairment, with atrophy even to the degree of sexual infantilism.

So marked are the relations of the anterior pituitary and the sexual system that some have even considered parturition to be due to the final accumulation of pituitary secretion. At all events, this latter might account for the glycosuria of pregnancy; moreover, after multiple pregnancies we frequently see adiposity, loss of hair, changes in the skin, and a subnormal temperature, all of which are evidences of hyperpituitarism.

The overgrowth of the pituitary sometimes occurring after typhoid fever or its clinical evidences are to be considered as the result of toxins which stimulate its own growth, as well, perhaps, as that of the epiphyseal bony boundaries, thus accounting for excessive overgrowth after this fever. Something of the same kind is often seen after marriage, when the stimulation of the sex glands seems to extend in a short time to the hypophysis.

The anterior hypophysis discharges its secretion directly into the blood stream; it has, moreover, its own separate blood supply. Its total extirpation in healthy animals seems to prove fatal. It seems to have a very important part in regulating skeletal growth, its enlargement being usually followed by acromegaly and hypertrichosis. It also enlarges during pregnancy, and to some extent after removal of some of the other ductless glands, presumably as a compensatory feature.

The posterior hypophysis has also its own blood supply, and discharges its secretion into the cerebrospinal lymph. When overactive it produces adiposity and changes in the skin similar to those of myxœdema, causing it to become dry, coarse, wrinkled, and furrowed. It has much to do with the sexual system and causes dystrophy and atrophy of the sexual organs. It seems to retard rather than promote skeletal growth. When overactive it leads to a high sugar tolerance, and when underactive to a conversion of sugar into fat, with increase of weight. When enlarged it exerts pressure and may thus lead to hydrocephalus internus. Its extract acts as does adrenalin, is a powerful galactagogue, and increases peristalsis. When overactivity gives way to reduced activity the skin becomes œdematous and characteristic psychic disturbances are met, such as drowsiness, hibernation, even epileptiform seizures.

In brief, the symptoms of dispituitarism may be briefly summarized as follows:

| | |
|---|---|
| Reduced activity | Adiposity,<br>Sexual infantilism,<br>Skeletal infantilism; |
| Overactivity | Gigantism—type Launois in the young,<br>Acromegaly—type Marie in old. |

Pinealism may simply be mentioned here as characterized in children by abnormal growth, including that of the hair, obesity (adiposity), drowsiness and precocious (premature) sexual development, all of which may suggest the existence of tumor of the pineal body, or at least of overgrowth. In these sexual traits there would seem to be an antagonism between the pineal, which causes premature development, and the hypophysis, which causes rather the reverse. It includes also hypertrichosis, static irritability, oculomotor paresis, and hydrocephalus internus (pressure?).

The enlargement of the hypophysis during pregnancy is of peculiar interest and has only recently attracted attention. It pertains mainly to the anterior lobe, which at-

tains sometimes a size two and one-half times greater than the normal, while of this increase in bulk at least four-fifths appears to be made up of new-formed cells; in fact it is occasionally large enough to make pressure on the chiasm and thus seriously compromise vision, even to the extent of temporary blindness, which, as all know, sometimes occurs during pregnancy. It is accompanied by noticeable changes in other parts of the body, especially the upper, such as formation of osteophytes on the inner surface of the skull, deposit of calcium salts about the upper jaw, nose, temples, and ridges, and an entire change of facies, including thickening of the nose and lips, and even enlargement of the glands, all of which are most suggestive of acromegaly; in fact, March has reported a case of outspoken, acute acromegaly occurring during pregnancy.

To be more descriptive and complete, the symptoms of involvement of the hypophysis include the following, which are usually distinct and definite enough to aid generally in localization: Severe, persistent headache, due to increased intracranial pressure, particularly well marked when the body is large enough to press upon the optic nerves, and especially in the upright position. Exophthalmos, which is not outspoken and is due to pressure upon the veins (Cushing), along with trigeminal neuralgia, with fullness and tortuosity of the veins of the scalp. These symptoms are often accompanied by adenoids. Skeletal overgrowth, including gigantism and acromegaly, between which a distinction is certainly to be made. Massolongo's epigrammatic generalization that "acromegaly is delayed gigantism" has been quite generally accepted, as well as that of Launois and Roy that "gigantism is the acromegaly of subjects whose epiphyses are not yet ossified as they should be at their respective ages." However, we must emphasize that not all giants are acromegalics, and here perhaps may come in the important distinction between the gigantism of pituitary origin and that chargeable to the thymus.

Skeletal undergrowth, infantilism, and the like pertain to very early, perhaps to prenatal, influences. We must distinguish between the infant dwarfism of Lorain and true *nanism*, where only certain morphological proportions persist or are retarded. The former is in fact best termed *miniaturism*, where the development is throughout symmetrically retarded. We have also to distinguish between *ateliosis*, or perpetual youth, and *progeria*, which means an anticipated old age. This distinction is of course easy. We must also remember Herter's type of infantilism, which is really due to a chronic intestinal infection, as well as the experiences of others who have shown that by feeding young animals isolated proteins alone actual growth is inhibited, although body weight seems to be maintained.

As between the hypophysis and the sexual glands there seem intimate relations. The result of castration is increase in size of the pituitary. Fischera and others have shown that in capons and oxen the hypophysis is often double the size of that in cocks and steers. Jutaka Kon has observed the same enlargement in bodies of castrated women, while others have reported it among the Skoptsy.[1]

If there be truth in all this, then some of the popularly dreaded results of castration in women may be ascribed to hypophysial enlargement and to other phenomena which follow it. While all of this seems rational and is certainly interesting, Falta nevertheless takes exception to it.

### *Influence of the Ductless Glands in General on Growth and Development*

In youth a loss of the genital glands leads to overgrowth of the truncal skeleton, while the cranium does not seem to grow so fast. The distribution of fat about the body is disturbed. Epiphyseal consolidation in those locations where it naturally occurs least or last is delayed. This will account for the overgrowth, and it is not necessary to seek for its cause in the pituitary. The sexual glands, especially at puberty, exert a marked influence over the development of the bones during the last portion of adolescence.

The thyroid, when early lost or reduced

[1] Ziegler's Beitr., 1908, xliv.

in size or when it has suffered involution, seems to cause dwarfism or limitation of growth in every dimension. The fontanels remain open, the root of the nose sinks in, and enchondral as well as periosteal ossification is delayed.

Early involvement or defect of the hypophysis is also followed by limitation of skeletal growth, but not so marked as that due to defective thyroidal influence. In some respects it is harder to distinguish, but when the hypophysis is involved development of the genitals and the interstitial glands is even more marked. Acromegaly in the young is accompanied by more than marked eunuchism, and its secondary sex characteristics are more pronounced.

As between dystrophy of hypophyseal origin and true infantilism, it is to be noted that in the former the mind is but slightly affected, while there is frequent headache sometimes with vomiting, and that in the latter the mind is of infantile type and headache and vomiting are uncommon.

Only when the ideal type or model throughout the body is maintained can we assume a perfect harmony of action between these various glands. Departures from the standard can often be ascribed to or found in disturbed relations or, possibly, perceptible or even visible alterations.

### *Infantilism*

This name was suggested by Lasegue as descriptive of the persistence of infantile conditions and growth into the years of adult life. Its first accurate description was given by Lorain, and the first good case record is that of a 24-year-old female dwarf, by Dancel and Baillager.

The type is susceptible of further classification; for instance, Brissaud describes a form which he considered due to early thyroid infantilism as distinguished from the Lorain type, which to him is due to a general and complete retardation, arrest, or defective development, in which no one particular organ is at fault.

Perhaps the best classification of types of infantilism is that offered by Anton, and is as follows:

Infantilism with myxœdema and cretinism;
Mongolism;
Infantilism due to inactivity of the genital glands;
Infantilism with primary disease of the visceral glands, namely, thymus, adrenals, and pancreas;
Dystrophic infantilism due to
Vascular insufficiency;
Primary brain lesions, of one or both hemispheres;
Hereditary syphilis;
Alcoholism and other poisonings (habit or occupational), or by inheritance;
Early and precedent tuberculosis, chlorosis, or cardiac lesions;
Starvation, bad food, environment, or faulty position (as in school), typhoid, malaria, pellagra, etc.

To these Falta adds

Infantilism due to partially defective activity of the genital glands;
Infantilism of true psychic origin (whatever that may be).

Schüller would make but two principal types, namely:

A dystrophic type, due to hereditary or prenatal, i.e., very early, influences;
An acquired type, due to distinct abnormality in one or more of the ductless glands.

In all of these forms there is subinvolution of the entire lymphatic apparatus, while ossification proceeds irregularly and body proportions are either reduced or altered. Our perception of irregularities of ossification has been made possible only by use of the röntgen rays.

### *Dwarfism*

Dwarfism differs from infantilism in this, that symmetry of development is not maintained, and is to be distinguished from true infantilism, for which perhaps the best name is *miniaturism*, of which Paltauf gave probably the best careful description in 1891. In dwarfism the infant is normal at birth, after which it may assume either of two distinct types, or perhaps an intermediate form. These are:

Primordial nanosomia, where the changes begin at or before birth; and

Infantile nanosomia, where they begin in infancy or early childhood.

To these might be added:

Rachitic dwarfism, combined with ordinary manifestations of rachitis, while mentality is not affected and the sexual system is normal; and

Achondroplasic dwarfism, combined with abnormal ossification and hyperplastic exhibits at the epiphyseal joints, clubbing, etc. Here periosteal bone formation may be excessive and deformity of skull and spine often occurs, as well as too early synostosis of the cranial sutures.

### *Mongolism*

This type was first described by Langdon Down, deriving its name from the resemblance in physiognomy to that of the Mongolian races. It is characterized by a small skull, with a round, small fissure between the eyelids which has an oblique direction (sometimes with epicanthus); nose small and even button-like, with sunken root or bridge; small mouth, with disproportionately large tongue, often visible in repose, and cracked; protuberant lower jaw; hair soft and silky; eyes small, and the external ear somewhat triangular in shape. The thyroid is visible and palpable. The cranial openings persist, and the teeth are defective. Ossification is nearly normal. The skin is smooth and soft and general adiposity is frequent. The pseudolipomata of infantile myxœdema are not present. The genital development is usually normal, and mentality is rarely seriously impaired.

### *Gigantism*

In this condition, as differentiated from acromegaly, it is difficult to state just where abnormality begins, but it is usually with evident disproportion or disturbance of the normal symmetrical type, sometimes accompanied by disturbance of function, as in eunuchism. So far as types are concerned there are practically but two — the *eunuchoid*, which may be described as infantile, early or late; and the *potent* type, in which the sexual function is not disturbed. Little is required in this description save to remind that, as a rule, giants are short-lived. Gigantism is usually accompanied by overactivity of the adrenal system.

Differential diagnosis as between dystrophia adiposogenitalis due to influences relating to the hypophysis, as compared with that form pertaining to defects in the genital glands, may perhaps be assisted by the following presentation:

| *Hypophysis at fault:* | *Genital glands at fault:* |
|---|---|
| Usually accompanied by symptoms of brain pressure. | There are no intracranial symptoms. |
| Reduced carbohydrate metabolism. | No changes noted. |
| Early closure of epiphyses. | Epiphyses ossify later. |
| Little alteration of body proportions or dimensions. | Dimensions reduced (height and width together); gynecomasty in severe early cases; in some of these growth may cease.[1] |

### THE THYROID

Even to-day there is much to learn concerning the functions of the thyroid. It was once regarded as a reservoir by means of which blood pressure in the brain was equalized. It seems to have an influence on the formation of the blood slightly resembling the action of the spleen, possibly vicariating for it. The most important part of its work appears to be elaboration of *iodothyrin*. Certainly iodine is its most important constituent, and in this the thyroid is richer than any other organ. In effect, or accurately speaking, this is really an iodothyroglobulin, which forms a large part of the weight of the thyroid (from one-third to one-half), and even three-fourths of the weight of colloid goiters. In goiters quite free from colloid the thyroglobin contains no iodine, and in hyperplastic (exophthalmic) goiters it is reduced in amount, while in the latter the phospho-albuminoids are increased. (Thyroidin may be made by

[1] Very recently the French have been describing several types of gerodermia, meaning thereby that appearance of the skin which we consider especially characteristic of old age. (Feindel, Paris Médical, 1913, Oct. 18); and an Italian, Ciauri, in a recent volume, distinguishes the following forms:

Gerodermia pseudo-acromegalic, including a hereditary form;
Senilism pseudomyxomatous;
Gerodermia genito-dystrophic, with infantilism in other respects;
Senilism, with feminism;
Gerodermia genito-dystrophic among women.

Among other notable features he describes and illustrates a peculiar appearance of the integument of the face remarkably resembling that of the skin of an orange deeply pitted.

boiling the thyroid for several hours in a 10 per cent solution of sulphuric acid and extracting the residue with alcohol.) E. Cyon thought iodothyrin was formed rapidly when the thyroid is flushed, and that it stimulated the regulator nerves of the heart and thus relieved the blood-vessels, permitting their expansion and thus reducing blood flow to the brain.

The thyroid seems to regulate or lessen deposition of fat and, by regulating those organs which if overactive seem to retard it, to permit normal growth to occur. It seems also to exercise a general regulator control over most of the other ductless glands, less so upon the adrenals than upon others. It affects especially the vegetative nervous system — that is, the sympathetic. Its hormone reacts on the very nerves which supply it, stimulating the vasomotor and perhaps inhibiting the pneumogastric. Between it and the female generative system exist most intimate relations, since it increases in size during menstruation and pregnancy, and even sometimes on deflorescence.

Its true purposes have been made known as much by the consequences of its removal as by experimentation. Of these, one type appears promptly and is characterized especially by muscular spasms and tremors and by many other features; and the other type slowly, in which type nutritional changes, cachexia, etc., appear. There also occur intermediate or transitional forms.

By experimentation it has been shown that extirpation of the thyroid in the carnivora causes early death, and among the herbivora, chronic cachexia. Later it was found that the parathyroids were essential even in the herbivora, and that if they were all removed any animal, even man, would die. Thus it was demonstrated that the thyroid itself is less important than the quartette of small parathyroids. In general, then, regarding the function of the thyroid it may be said that its final product is a hormone which is passed into the blood as an iodo-albumin, and that this modifies the activity of several other organs; thus it promotes catabolism and increases normal function. It helps in the disassimilation of a number of substances by producing others which affect the heart, the sympathetic nerves, the hypophysis, and the adrenals. It promotes skeletal growth and the development of the sexual glands, and it limits the internal secretory function of the pancreas. Whether this is done by direct contact with the tissue elements of the organs affected or through the mechanism of their nervous supply is as yet uncertain. For example, it may affect directly the sexual apparatus or by influencing the pituitary. Opinions differ as to whether there is more than one thyroid hormone, but at present the sentiment of the physiologists is in favor of a single hormone.

In any discussion of this subject we must not omit from consideration the fact that the thyroidal function may be more or less disturbed by the toxins of a chronic intestinal infection, especially in infants, which may thus result in disturbed relations in the whole ductless gland system.

Symptoms due to removal of the thyroid appear in at least 70 per cent of cases after extirpation, and Kocher has placed seven years as the possible duration of life after complete thyroidectomy. When these symptoms do not appear their absence must be due either to accessory thyroids or incomplete removal of the main body. Cachexia may appear even after partial removal, though in mitigated form. Horsley thought at first that six-sevenths of the entire thyroid might be removed with safety, but Kocher places it at three-quarters; while a spontaneous recovery from symptoms is possible, this must be due to hypertrophy of the remaining portion, which may even be regarded as a form of autotransplantation. On the other hand, even when an apparent abundance has been left the remainder may undergo such degeneration as to cause cachexia. We must not mistake every thyroidal enlargement for true goiter. It may be due to really degenerative changes with suppression of true function. We must not forget Kocher's statement—"there are goiters and goiters."

In the young and growing animal the most constant evidence of thyroid insufficiency

is disturbance in growth, shown by retardation in length and height (that is, dwarfing), due to imperfect ossification, with sexual infantilism and retarded puberty, and often also by arrest of mental development, with impaired intelligence, clumsy locomotion, and the general conditions suggestive of cretinism. Adults show lassitude or inertia, muscular asthenia, mental inactivity, waxy, thick, and puffy skin with consequent immobility of the face muscles and lack of expression, anæmia or subjective sensations of chilliness, œdematous mucous membranes in the pharynx, nose, conjunctiva, etc., and they complain of pains in the limbs and joints. Menorrhagia is the most frequent of features peculiar to women, while during pregnancy all the above signs and symptoms are intensified. Sterility is the rule in both sexes.

The relations of Dercum's adiposis dolorosa to the thyroid are far from clear, though the lassitude and mental apathy just mentioned, sometimes with psychic exaltation, are suggestive in spite of what we have learned regarding the hypophysis; nevertheless, the enlargement of the latter, with atrophy of the genital glands, may point to a diverse etiology.

Much stress has been laid on the fact that senility is characterized by atrophy of the thyroid along with many other changes. The latter are so numerous as to make it uncertain whether thyroidal atrophy is a cause or result, but there is much in the typical senile condition of the skin to suggest it.

Hypothyrosis includes infantilism, then, but comprises much more. It was Virchow who brought into prominence certain ethnological features and who introduced the terms *nanosomania infantilis* and *primordialis*, subsequently accepted by Paltauf and others. In the former the young child, after having a fair start, ceases to grow. In the other, dwarfing is due to arrest almost at the outset. In the former the babe is of normal size at birth, but at some later yet early period ceases to grow. In the latter it is a miniature even at birth, yet may attain a sort of completeness, with complete ossification and sexual maturity. Some great men have apparently been of this type. Adults of the infantile type have been described as appearing like ordinary men and women viewed through the wrong end of an opera glass (Dayon).

In achondroplasia there are no characteristic mental defects, but the body displays striking disproportions, such as shortness of limbs and relatively greater length of trunk and head. Its most pronounced pathological feature is defective epiphyseal union.

Mongolism implies arrest of natural growth, with abnormal growth of cranium and facial bones; depression of nasal bridge, open fontanels, thickened tongue, defective sexual development, and notable mental abnormalities, apathy, somnolence, and later a perfectly unreasoning bodily activity. The eyelids assume an oblique angle; the skin shows few if any changes. The bones develop naturally. The thyroid is usually normal, and thyroid feeding is of no benefit. Alt and Schüller believe mongolism to be in fact a primary dysgenitalism.

### THE PARATHYROIDS

Only within late years have these four little bodies been given their proper consideration, and in this short time have attained an importance in pathology quite disproportionate to and in inverse ratio with their size. It is now generally believed that nearly all cases of tetany in man are of parathyroidal origin, and due to defective function and consequent evidences of hypoparathyroidism. Even that form of tetany occurring in the puerperal state is to be explained in the same way; in fact it would appear that pregnancy may provoke an outbreak of this kind or of a condition previously latent. It is now well known that the tetany of infants is often due to hæmorrhages, i.e., apoplexies into these little bodies. Tetany of so-called gastrointestinal origin is difficult to explain, but must be due to a suppression of parathyroidal activity due to some toxic products elsewhere produced.

It is of interest that Fleischmann found that among those who had had an earlier history of infantile tetany the teeth showed a marked defect in their protective enamel covering. It is known also that the parathyroids succumb easily to tubercular infec-

tion; hence, perhaps, the frequency with which the Chvostek phenomenon, i.e., facial spasm from a tap on the outside of the face, may be produced in tubercular patients.

### THE THYMUS

The thymus seems to have much to do with the development of the entire bony system; when its activity is reduced ossification is much interfered with, and proceeds irregularly and from scattered points. Sometimes it fails utterly, as when the first pair of ribs fail to ossify, and the others are left weak and subject to early deformity. When this happens the sternum is usually disproportionately wide; the bones all lack in mineral constituents and become so soft that they may even be cut with the scissors; later this softness and flexibility may give way to fragility and brittleness. The larger epiphyses (hip and knee) may still be cartilaginous when the shafts are already brittle. In animals thymectomy produces osteomalacia, as well as an osteo-arthritis much like that met with in rheumatism or tabes. The hair undergoes changes and becomes either very soft and downy (hypertrichosis lanuginosa) or the reverse, i.e., stiff and bristly. Corresponding defects in dentition occur, the teeth being really epithelial products as well as the hair. There are other accompanying congenital defects, such as rudimentary uterus, mammæ, etc.

Peculiar relations obtain between the thymus and the genital glands, since it persists much longer after castration, while its removal is often followed by a hypertrophy of the external genitals. Redlich's case of infantile gigantism had this peculiarity.

The thymus seems intimately concerned in the production of the *status lymphaticus* and the so-called *thymic asthma* in which conditions along with hyperplasia of the thymus itself, goes an accompanying participation of the entire lymphatic system, including the tonsils, the follicles of the tongue, stomach, intestine, and spleen, which are all lymphoid structures, while the bone-marrow becomes very red. In these cases there is defective development of the genital system. The entire chromaffin system seems to suffer from hypoplasia, as shown by low blood pressure due to defective adrenalin secretion.

The relations of the thymus to the conditions known as achondroplasia seem very positive, though not very distinct. This condition is one of irregular dwarfism, in twelve cases of which Jensen found the hypophysis reduced in size. The explanation would include in general those dwarfs who in time past have been made court jesters or court fools, and have played no small part in history. It is a curious fact that the ancient Egyptian deity, Ptah, is represented as a dwarf with crooked legs. The term achondroplasia was devised by Parrot, who in 1876 was perhaps the first to ascribe to it an identity of its own. It may, moreover, include such defects or deformities at the base of the skull as to stand in relation with changes in the hypophysis.

Cranial defects are common, and spinal curvatures may often accompany the condition. When an infant dwarf is raised by lifting it under the arms it usually cannot be made to sit up, the relatively large head cannot be maintained in proper position, and the efforts usually made to prop it up result in these curvatures.

Basal pressure between the second and eighth weeks of fœtal life affords a tempting explanation for some authors. This may be effective, either within or without the skull, or may be made so by the almost doubled-up position of the fœtus *in utero;* or it may occur within the amnion, from hydramnics — in other words, from lack of space accommodation. Whatever deformity is produced by participation of the amnion occurs within the first six or eight weeks of intra-uterine life. Amniotic pressure may produce deformities purely mechanical, or by a disturbance in the very early stage of bone formation. Jensen[1] believes also that narrowing or limitation of the amnion is a factor transmitted by heredity in many families, and that numerous teratomata are ascribable to this influence.

Naturally, when pressure is made cartilaginous structures suffer most; and its effects may be seen, for example, in the very flat

[1] Zeitschr. f. orth. Chir., xxxii, 1.

noses of some new-born infants, also in harelip, micrognathy and agnathy, hydrocephalus, etc., as well as in defects of the thyroid and thymus as the sheer result of pressure, the order of phenomena being about as follows: Increased amniotic pressure; deformity of the embryo; pressure effects upon the hypophysis, thyroid, and thymus, and consequent disturbance of their functions and perversion of their secretions.

Both Hochenegg and Kocher have reported most illustrative cases showing how, after removal of the anterior hypophysis, there is reduction in dimensions, the hands and feet rapidly becoming notably smaller. If achondroplasic dwarfism were due to overactivity of the hypophysis the cranium would show overgrowth, as do the long bones and the lower jaw, but this condition does not appear until after birth; moreover, in acromegaly and gigantism the sexual instinct is lowered or lost, as it is not in achondroplasia — rather the contrary. By these facts, then, we may the better decide as between responsibility of one gland or the other.

Jensen regards it as probable that the future will demonstrate that these changes in the jaws, hydrocephalus, harelip, and the expressions of athyroidism and athymism, are due to abnormal curvature of the embryo owing to a diminished amniotic space; that the gas cysts formed in these inner organs are due to increased hydrostatic pressure; and that adiposity and increased sexual activity are to be ascribed to the secondary and indirect pressure effects of such displacement, by which the posterior hypophysis is affected.

Summing up the conditions ascribable to amniotic pressure, we have first to appreciate that the overstretched amnion is capable of causing pressure on its contained embryo sufficient to affect its secretion and influence its shape and position, even to a degree permitting important alteration in many respects, and that by diminishing blood supply a general dwarfing may be produced. Individual peculiarities of each case will determine its prominent features, but cartilage and bone both suffer early and variously, while in consequence thereof alterations are manifested in the viscera and in the ductless glands. The achondroplasiac is therefore an amniotic dwarf, so conditioned during the earliest weeks of its amniotic life, and there is scarcely a limit to the abnormalities and effects which may result therefrom.

Curvilinear compression, then, due to such pressure, predetermines the deformities, internal and external, of the achondroplasiac, the extent of which is a measure of the time and extent when and to which pressure was first made, while teratomata are but extreme manifestations of the same kind.

### THYMUS AND THYROID

Increasing attention is being paid to the interrelations of these two bodies in that symptom-complex known as exophthalmic goiter. The more closely we study it clinically the more composite seem its features and the more interchangeable, at least in some respects. In fact, so sharply are the German pathologists[1] differentiating between the two that they speak now of Basedow-thyroid and Basedow-thymus. Undesirable as are these terms to us, it may be that we shall have to accept them until better English equivalents are offered. Certain it is that undue activity of one seems to excite the other, the reverse being equally true.

The effect on animals of the injection of their juices or transplantation of their tissues is much the same. Gudernatsch, in certain feeding experiments, fed one set of animals with thyroid and another with thymus; with the former he produced dwarfing, with the latter the contrary, but the former could be overcome by thymus feeding. It is found in man that the mildest type is that in which apparently only one organ is involved, while extirpation of either one alone leads to a reduction in the degree of symptoms of either type, along with a reduced lymphocytosis. It would therefore be tempting to regard each organ as having its own secretion, with its own distinct type, were it not for the effects of adrenalin, which seem to indicate quite the reverse and to disprove their completely separate character. Moreover, their embryology would argue against their complete separation. Anatomically, the cylinder cells

[1] Capelle and Bayer. Beit. z. klin. Chir., lxxxvi, 509.

of the thyroid are regarded as concerned with the sympathetic system, and the polymorphous cells as evidencing the vagus capacity of their component tissues. Tandler and Gross have observed persistence of the thymus among the Skoptsy, while others have noted increase of development of the genital glands after thymectomy.

Again, between the thymus and the entire chromaffin system, including the adrenals, there exists a marked interrelation, since with insufficiency of the latter, as in Addison's disease, goes increase in size and activity of the thymus.

The *adrenalin test* is applicable to all cases in which it is desirable to make it. It is necessary before making it to determine the clinical intensity of the symptoms, the blood picture, and the renal elimination as to glycosuria and polyuria, and the relation of the latter to perspiration, specific gravity, etc., since, according to Saardermann,[1] the more intense the symptoms the more pronounced are the reactions. He advises to inject 0.001 of adrenalin, in two sittings, at intervals of one-half hour, although to some this would appear heavy dosage. In struma simplex with one-half of the patients, at least, there will be no reaction and no glycosuria. In all cases perspiration will cease, while only rarely is there subjective sensation of heat. In patients not above 20, if sugar be present at all it is so in but slight amount. At ages from 20 to 40 there is usually some trifling polyuria, and with it perhaps a small percentage of sugar. After 40 the test is less distinctive, and there is diminution in one or the other, or both; or both may be lacking.

In exophthalmic goiter adrenalin causes more marked perspiration, with palpitation and tremors. When glycosuria and polyuria as well as perspiration are greatly increased, then we may regard the sympathetic system as overloaded, while reduced perspiration indicates a much milder form. When perspiration is entirely lacking and the skin is dry it shows that the pneumogastric is overworked. In the latter group of cases lymphocytosis is diminished, sometimes even within a few hours after the adrenalin is given.

[1] Ztschr. f. exp. Therap. u. Path., xii, Heft 3.

### THE ADRENALS AND THE CHROMAFFIN SYSTEM

These are the only members of the ductless gland system which have not, to some extent at least, been considered as quite legitimate field for surgical endeavor, the instances of attack upon these bodies being very rare, and under peculiar pathological conditions such as are seldom duplicated. Nevertheless their reciprocal interrelations with the other ductless glands are just as interesting and just as important. When the adrenals are removed in rabbits the hypophysis enlarges; their medullary portion is the most vital, and its hormone enters the blood via the suprarenal veins. This secretion preserves the tonus or equilibrium of the nerve-centers of the heart and blood-vessels, as well as of all the respiratory muscles — possibly, indeed, of the entire muscular system.

The cortex belongs, properly speaking, to the chromaffin system, and is capable of assuming, at least to a small extent, the work of the medullary portion, while after removal of the latter it undergoes hypertrophy. Adrenal insufficiency causes asthenia, apathy, muscular atrophy, and finally paralysis, shortly prior to death. It causes also pigmentation. In some roundabout way it may lead to hydrocephalus internus, since in five cases of this condition Czerny could find no medullary substance.

Insufficiency may be produced in consequence of acquired or congenital atrophy, hypoplasia, and cirrhosis, or it may, on the other hand, be the result of local tuberculosis, syphilis, or tumors. No matter what the active cause, pigmentation is always an accompaniment and serves to differentiate diseased conditions.

The pigmentation noted during or after pregnancy, as seen along the linea alba and at the umbilicus, labia, nipples, face, and "chloasma uterinum," as well as increased growth of hair, even formation of a beard, are to be ascribed to the adrenals. Sometimes the excess of hair is lost after delivery. Halban demonstrated much the same thing in animals after shaving their abdomens; he ascribes this to the adrenals, which he found to enlarge during pregnancy.

THE VEGETATIVE SYSTEM

This is a term now in quite general use, comprising what we used to call the sympathetic and possibly the trophic nerve-systems. It was introduced by Kundrat. Disturbance of this vegetative system implies developmental retardation not directly ascribable to primary lesions in the ductless glands.

The term *vegetative* includes also the visceral nervous system, the ganglionary and autonomous system, and the three great plexuses which Gaskell has described as the cranio-cervical, the thoracic-columnal, and the sacral, along with Auerbach's and Meissner's ganglia and the fibers which they receive from the other system and from the anterior roots after they leave the spinal cord. This system supplies all the glands having ducts, as well as all the involuntary muscles and the muscular organs, including the heart, bronchi, alimentary canal, gall-bladder and ducts, bladder and ureters, the pelvic organs, the small hair muscles, and the blood-vessels. These ganglia have been happily spoken of as "switch-boards," and some of the nerves pass through two or three of them. It includes also the oculomotor, chorda tympani, the vagus, and the pelvic nerves, which as a group have been called the *vagus group*. It should perhaps be emphasized that the sympathetic and the vagus groups are more or less antagonistic. The tendency to-day is to look more to this so-called vegetative system and the hormones and less to the trophic nerves for explanation of various phenomena under present consideration.

The entire chromaffin system, and especially the medullary part of the adrenals, is under control of this system, and bits of chromaffin tissue are scattered throughout the sympathetic nerves. The actual material secreted by this system, no matter where found, is adrenalin. After extreme muscular activity the chromaffin cells lose for a time their chromaffinity; in other words their adrenalin is consumed (Schur and Wiesel), and the amount of adrenalin in the blood serum is increased. This means that during their activity a large amount of glycogen is used, melted down; that is, the mobilization of glycogen is governed by the chromaffin system.

*Pluriglandular Disease*

Under the term pluriglandular, implying obviously the participation of two or more of the ductless glands in the etiology of a given morbid condition, the French especially have introduced a term which is convenient, and yet fraught with some danger — danger, that is, to our clearer comprehension of the nature of the diseases under consideration. Yet underlying this danger is a generalization of truth and fact which, in order to avoid one, needs a candid statement of the other.

This basal fact is that the ductless glands actually are so complex in purpose and function, and their interrelations so complicated, that in many instances, in order to identify the organ primarily at fault, we are in sore need of much more accurate knowledge of function as well as an earlier study of cases, than is usually permitted us. Many of these cases wander from family physician to specialist, and then back again; the former is perhaps too concerned with the general fact that the patient is really sick, while the latter interrogates mainly the particular organ in which he is especially interested. Thus by the time the patient comes under observation of the really competent "universal specialist" the clinical picture is so diversified that a proper location of the primary fault is well-nigh impossible. It is the old story:

The centipede was happy, till one day the toad, in fun,
Said, "Pray, which leg comes after which?"
This excited him to such a pitch
He lay quite helpless in the ditch,
Not knowing how to run.

Once the habit is formed of simply recognizing a pluriglandular disorder as such, all scientific accuracy is put aside, and therapeutic efforts assume an experimental or empiric character which impairs rational and well-directed effort. Whatever, then, of benefit accrues from such treatment, while welcome, is not conducive to accurate advice. Let us, then, acknowledge that while disturbances of really pluriglandular type occur not infrequently, we must yet make effort to trace symptoms to their primary, i. e. their real, source.

Falta's definition or description of what should be the real nature of a general condition entitled to this designation is well founded and should be generally accepted. By this term he would imply a condition due usually and originally to an infection which may or may not be traceable, involving almost simultaneously more than one of the ductless gland system, leading to well-marked atrophy, usually of the sclerotic type, and without apparent reason for such selection. In this possible involvement the thyroid, hypophysis, adrenals, and the genital glands usually figure, and we accordingly find evidences of thyroidal and pituitary insufficience, sexual impairment, combined perhaps with symptoms reminding one of Addison's disease, such as debility, pigmentation, and the like. Most conspicuous and almost universal is cachexia, pronounced, but of ill-defined type.

The infection underlying this vicious circle may be of various types. Gonorrhœa and syphilis are perhaps no more likely to be followed by the condition than typhoid, influenza, or tuberculosis; in fact the latter figure prominently. Too often one of these has preceded the other, so that accurate history is impossible to secure. Claude and Gougerot have gone so far as to postulate a congenital or inherited weakness of the entire gland system as a contributing cause, or as so reducing resistance that a comparatively trifling temporary or short-lived infection may easily result; all of which is self-evident. Alcoholism may also be mentioned in this connection.

Gilford's[1] and Jonathan Hutchinson's *progeria* and Variot's *senile nanism* are types which pluriglandular disease may produce. These writers both describe cases remarkably similar in their diminutive stature, extreme emaciation, thin, wrinkled, and almost folded skin, small lower jaw, slender bones with premature ossification, clubbed bone ends, and congenital retardation. Gilford ascribed the trouble to the hypophysis, Variet to the adrenals. But, as Falta shows, the premature ossification may have been due to a separate cause; their normal mentality speaks for thyroid insufficiency, while the infantile distribution of hair may have been due to adrenal insufficiency or even to mere atrophy of the skin.

In all this consideration we must not forget that the ductless glands may have been congenitally defective, and that we must not always ascribe all secondary changes to their perverted secretions.

As Gilford[2] says, "By experimental study alone we are lost in the mazes of abstract science, while by clinical research alone we arrive at premature and unscientific conclusions." In his opinion we must turn to pathology and study what happens when one or another is diseased. Initial correlations are established with the first penetration of the ovum by the spermatozoön, and continue until the ductless gland system is elaborated. He is compelled (and probably we, too) to assume some faculty of adjustment and subsequent correlation quite apart from either that system or nerve influence. What constitutes the machinery or mechanism of this later regulation is one of our greatest problems.

### *Osteomalacia*

Osteomalacia is a disease evidently due to disturbed internal secretions which at the same time cannot be placed in any particular category because of our still defective knowledge. It occurs mostly in women and appears to be due to excess of ovarian hormones, since it is relieved, improved, or even cured by castration. One puerperal or post-puerperal attack seems protective as against others during subsequent pregnancies. When occurring during pregnancy, castration can be performed without necessarily disturbing it.

It occurs also in connection with Graves' disease, and even along with it and tetany combined. Cases have been reported where the symptoms of Graves' disease have changed into those of myxœdema, and later again into a puerperal osteomalacia. In this condition the glycosuria, etc., produced by administering adrenalin, and even its effects upon the heart and vessels, are much less pronounced

[1] Gilford. "The Disorders of Post-Natal Growth and Development." 1911, London.

[2] Lancet, Lond., 1913, Sept. 6.

than in other conditions, conspicuously less during pregnancy. As also showing the pluriglandular nature of the condition, certain cases have been improved by the injection of pituitary extract.

Osteomalacia is quite different from rickets in that it occurs sometimes in endemic form, appears only in adults, and is not painful. The so-called rheumatic or rheumatoid form is a misnomer.

*Chlorosis*

Chlorosis is also a disease, probably of pluriglandular nature, which begins usually at puberty. We naturally seek for its cause in disturbed activity, usually reduced, of the sexual glands, while participation of the other glands, thyroid, chromaffin system, and the bone marrow, is a secondary feature.

THE MAMMARY GLANDS

The question whether the mammary glands have an internal secretion of their own is as yet undecided, but will furnish at least a reason for their mention here.

There are four periods of mammary activity:

The eighth or ninth month of fœtal life;
Period of puberty;
Menstrual period, or the day before it;
Pregnancy.

For all but the last of these the ovary furnishes the impetus.

As between the ovaries and the mammæ there obtains very intimate sympathy. This is a matter of daily experience among women, but is noted in disease conditions; for instance, the fact that actual ovarian disease disturbs the mammary function and activity, and that Starling obtained a cactostabile substance from the ovaries which, when injected into non-pregnant animals, caused enlargement of the mammæ and even lactation. Moreover, menstruation often causes sufficient mammary activity to lead to secretion of colostrum previous to the period and even of milk after it, while there is sufficient trophic activity at puberty to produce very significant development of gland elements.

While pregnancy naturally gives the greatest impulse to the breasts, it is not necessary here to invoke the ovaries, since there are a number of cases on record where castration shortly after conception has not prevented enlargement and lactation.[1] Furthermore, transplanted breasts have yielded milk.

Milk formation goes with the termination of pregnancy, even with miscarriage, whether premature or at term. Consequently some have held that the fœtus itself furnishes the hormone which stimulates lactation (Starling, Biedl, Foa), while others ascribe it to the chorion epithelium (Halban), since the death of the fœtus does not interfere with the act, but when the placenta dies no milk is produced.

It was a full appreciation of this interrelation which led Beatson to the suggestion of removal of the ovaries in inoperable cancer of the breast, and which has led others to the suggestion of removal of the breasts in order to limit ovarian activity in some extreme cases. A few trials of Beatson's suggestion have led me to believe that it may occasionally be of value.

THE TONSILS

The tonsils have recently been alluded to as "lymphoid structures with a short period of usefulness."[2] These little bodies are not fully developed until the end of the first year, and have a natural tendency to disappear by the end of the seventh, which, however, in our climate does not often occur. George Wright has also shown that the periods of greatest tonsillar activity coincide with the periods of molar dentition, i.e., second, sixth, twelfth, and seventeenth years, at which last age the "wisdom teeth" are making their appearance. But there may be other reasons for this aside from the conclusion which Wright seems to draw. While the lymph flow seems to be outward, and while it carries an unusually large proportion of lymphocytes, the same interstices through which they escape afford lodgment for bacteria, which latter are not by any means all destroyed by the lymphocytes, acting as phagocytes, even if they can so act, which some deny. Assuming the correctness of the view that tonsillar inflammations are caused rather by their toxins than by the bacteria

[1] Mainzer. "Doppelseit. Ovariot. bei Schwangeren." München. med. Wchnschr., 1895, p. 1117.

[2] Freema. Ann. Otol., 1913, March.

themselves, the tonsillar crypts certainly offer ideal foci for infection. Schönemann painted one side of the fauces with coloring matter and found that the pigment passed quickly into the tissue of the tonsil. He considers the tonsil to be a genuine lymph gland, i.e., like other lymphoid tissue. Good and Sheedy have suggested that the crypts are practically culture tubes in which are carried those bacterial growths by which a protective immunization is afforded.

The tonsils have been characterized as the "sentinels of the body," but are scarcely more protective than is the schneiderian membrane. While they are frequently "ports of entry," they are doubtless a part as well of our protective mechanism. Their hypertrophy is by no means confined to the frail and puny, but is fully as often seen in the robust.

Their real function, be it what it may, pertains to early rather than to later life. Whether they have an internal secretion or not they are really disturbed by secretions produced elsewhere, and, belonging as they do to the inflammable, almost tinder-like lymphoid tissue of the body, a collar of which surrounds every vestigial or embryonic canal, they succumb so easily to infection that they reinforce toxins or hormones produced elsewhere, even though they produce none themselves; while they cause such active and violent participation of other tissues, and they so seriously incommode the patient, that they deserve brief mention here, whether they are actually ductless glands or not.

In conclusion, it will be of advantage to make two brief lists, one illustrating conditions pertaining to the ductless glands in which operation may be considered, and another illustrative of operations which these considerations may require.

#### CONDITIONS WHICH MAY REQUIRE SURGICAL INTERVENTION

*Thyroid* — Extirpation, which must be partial, save when dealing with malignant disease; ligation of blood-vessels; transplantation or grafting.

*Parathyroids* — Here we can scarcely do more than transplanting.

*Thymus* — Extirpation or transplantation.

*Adrenals* — Transplantation, or possibly extirpation of one.

*Cachexia ovaripriva* — Has been relieved by transplantation.

*Hypophysis* — The anterior lobe may be incompletely removed; very rarely is complete extirpation practicable; transplantation has been attempted, so far with questionable success.

*Genital glands* — May be removed for various causes, but removal is rarely demanded for conditions under present consideration.

*Breasts* and the *tonsils* — Removal.

#### OPERATIONS WHICH MAY BE REQUIRED

In general, the character of the operations called for under the various conditions above mentioned include,

Transplantations (thyroid, thymus, adrenal, genital);

Craniectomy and decompression, for consequences of actual synostosis, and consequent microcephaly, etc.;

Operations for hydrocephalus;

Operations on the spine and limbs for various deformities;

Thyroidectomy and ligation of thyroidal vessels;

Thymectomy and operations required by pressure upon the trachea (tracheotomy);

Operations for consequences of osteomalacia, achondroplasia, etc., involving the pelvis (cæsarean section, etc.);

Operations on the teeth and jaws for various congenital defects, cleft palate, etc.

It will be seen, then, that perversion of the internal secretions may produce, directly or indirectly, consequential results which call for a very large and varied list of operations, in the performance of which the surgeon will be required to possess a degree of ability and skillful technique which may tax the resources of the best of us. It is a full appreciation of this fact that really led me into this study and made me feel that the general subject was one worthy of the attention of the physiologist and pathologist working in conjunction with the surgeon, but better yet the well-equipped surgeon should be a good pathologist and physiologist as well as a surgeon.

# SPASTIC TUMOR OF THE PYLORIC CANAL AND OTHER SPASTIC CONDITIONS OF THE STOMACH: THEIR SURGICAL TREATMENT[1]

By WILHELM LERCHE, M. D., St. Paul, Minnesota

As pointed out by Erik Müller (1), considerable confusion exists because the various anatomists have differed in their descriptions of the stomach and in the application of the names to the various parts of the organ. This is particularly the case with the pyloric end. A brief review is therefore necessary in order to explain the terms used.

The stomach was first considered a simple sac with an orifice of entrance and an orifice of exit.

To Willis (2), in 1682, is due the first description of the antrum pylori. He described it somewhat vaguely as an antrum *longum et capax* on the right side of the stomach, ending in a small orifice, the pylorus.

Cruveilhier (3), in 1834, gave the following description: About one inch from the pylorus the stomach, bending sharply upon itself forms a pronounced elbow (*coude de l'estomac*), and presents an ampulla which corresponds to an interior hollowing called by Willis the pyloric antrum, by others the small cul-de-sac or small tuberosity of the stomach.

Retzius (4), in 1857, found that the antrum did not have the same shape in all bodies; he mentioned three different forms. The antrum as depicted by him comprises the vestibule and the pyloric canal, which will be further discussed in this paper. Retzius also observed that in the newborn the part of the antrum next to the pylorus formed a short cylindrical tube about 1 cm. long.

Luschka (5), 1863, in his description of the antrum indicates that by this he meant a very small part of the stomach next to the pyloric orifice; Jonnesco (6) thinks that he confounded the antrum with the pyloric canal.

Gegenbaur (7), 1883, described it as a faint bulging on the greater curvature, which on considerable distention shows the antrum pylori.

Jonnesco (6) divided the stomach into (*a*) the fundus, whose lower limit is represented by a horizontal plane passing through the superior border of the cardia; (*b*) the pyloric part forming the inferior horizontal portion of the organ, its left limit being indicated on the lesser curvature by a notch marking the flexion of the stomach, and on the greater curvature by the latter's change in direction. He subdivided the pyloric part into the vestibule and the pyloric canal.

The pyloric vestibule is the small cul-de-sac interposed between the body of the stomach and the pyloric canal. The pyloric canal, first described by Jonnesco (8) in 1895, is the cylindrical part 3 cm. long between the pyloric vestibule and the pyloric orifice.

(*c*) The body of the stomach, or the vertical portion, is between the fundus and the pyloric vestibule.

Erik Müller (loc. cit.), studying the fœtal stomach, found the pyloric canal described by Jonnesco always present, and he adopted the latter's description and nomenclature of the pyloric part.

Cunningham (9), agreeing with Jonnesco and Müller, said that there is no part of the stomach which is more definite and distinct than the pyloric canal, and although it may be somewhat indistinct in adults, it can always be recognized. Its musculature is thicker than that of any other part of the stomach.

His (10) and Froriep (11) accepted the division of the pyloric part after Jonnesco and Müller, but His also proposed a nomenclature of his own.

Forsell (12) suggested the name "canalis egestorius" for the pyloric canal, "sinus" instead of the vestibule, and "fornix" for fundus. He described the canal as being 3 to 5 cm. long.

Beckey (13) found the length of the canal in adults varying from 2.5 cm. to 5.5 cm.; he does not consider the pyloric canal a fixed anatomical structure, but a contraction phenomenon. Wernstedt (14) seems to take a similar view.

Fig. 1 shows an inflated specimen of a stomach that I removed from a woman 26

[1] Read in part before Minnesota Pathological Society, March 18, 1913, and in part before Ramsey County Medical Society, May 27, 1913.

years old, in which the type of a pyloric canal described by Jonnesco-Müller-Cunningham is very well represented. A section through the pyloric part of this in the plane of the two curvatures is shown in Fig. 2.

The stomach walls are made up of three coats — the mucosa with the submucosa, the muscular, and the serous. The muscular coat consists of three layers — the outer longitudinal (thickest along the curvatures, especially at the lesser), the circular layer, and the inner oblique layer. The peculiar arrangement of the oblique layer is illustrated in the schemes of Forsell (15) (Figs. 3, 4, and 5). The latter found by dissection of the muscular layers and from his X-ray studies on the movements of the stomach in healthy persons that a constant and definite muscular architecture determines the characteristic contractions of the organ. According to Forsell the corpus or body of the stomach corresponds to the part between the upper and lower segment slings, as depicted in his diagrams.

Rüdinger (16) found that only the most superficial fibers of the longitudinal muscular layer are continuous with those of the duodenum, while the deeper ones in bundles dip down between the circular fibers of the sphincter pylori, forming arches. They constitute one-third of the thickness of the sphincter and were called by Rüdinger the "dilatator pylori." The balance of the sphincter is made up of circular fibers forming the "constrictor pylori." There is no continuation between the circular fibers of the pylorus and those of the duodenum, there being a connective-tissue septum between them.

Retzius-Gyllenskoeld (17) described a groove or channel along the inside of the lesser curvature of the stomach, which forms by the contraction of the oblique muscular fibers, and through which Retzius thought that saliva and fluids taken by mouth would pass directly from the œsophagus into the pyloric vestibule.

More recently this has been studied by Kaufmann (18), Waldeyer (19), and Lewis (20). Kaufmann observed the canal at postmortem in the human body, and produced it on dogs by injection of physostigmin (Fig. 6).

Hasse and Strecker (21) have described folds of the gastric walls corresponding to the canal of Retzius.

### Movements of the Stomach

Wepfer[1] (1679) was the first to study the gastric peristalsis in vivisected animals. He also noticed occasional deep constrictions near the middle of the stomach. Similar observations were made by Schwartz, and later by Haller. Home (23) considered the deep constriction dividing the stomach into a pyloric and a cardiac portion a normal condition during digestion.

Magendie (24) found that the cardiac part acted as a reservoir, holding the food and gradually forcing it into the pyloric part, where the chyme formation took place.

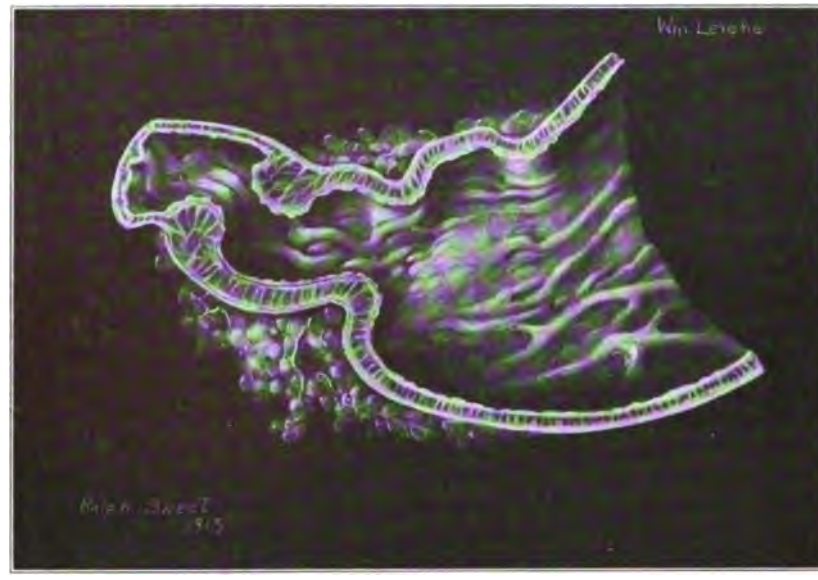
Beaumont (25), between the years of 1825 and 1832, made numerous experiments on Alexis St. Martin, who had a gastric fistula from an accidental gunshot wound. Some of his conclusions were as follows: In health, and when free from food, the stomach is usually entirely empty and contracted upon itself. The food first passes to the left and then along the greater curvature from left to right to the pyloric end, then returns in the course of the smaller curvature and repeats these revolutions, the whole contents being constantly mixed.

He observed the contraction of the transverse band, situated three to four inches from the pyloric end, by introducing a long thermometer toward the pyloric part during the latter stages of digestion. The constriction would relax and the thermometer was drawn toward the pyloric end as by suction and again forced back. Some of these observations were confirmed by Hofmeister and Schütz (26), who studied the movements on freshly removed stomachs of dogs suspended in a moist chamber, at body temperature.

Rossbach (27), studying the peristalsis in dogs in morphine narcosis through the open abdomen, could not verify the rotating motions described by Beaumont.

Openchowski (28) observed the constriction of the stomach in animals during the act of vomiting.

[1] Cit. by Cannon (22).



Section through the pyloric canal and the pyloric vestibule of the stomach of a woman 26 years old in the plane of the two curvatures. See Fig. 2. Two-thirds natural size.

With the introduction of the X-rays in the study of the gastro-intestinal movements, observations could be made under more normal conditions, and the incorrectness of some of the earlier views became evident.

Fig. 1. G, duodenum; H, pyloric canal; A, pyloric vestibule; B, body of the stomach; C, fundus; D, incisura cardiaca (His); E, œsophagus; F, incisura angularis (His); I, sulcus intermedius.

The first results of such X-ray investigations (on cats) were announced by Cannon (22) in May, 1897, and independently by Roux and Balthazard (29) in June and July, 1897. The latter experimented on frogs, dogs, and man.

With the introduction of the large bismuth meal of Rieder (30), in 1904, it became possible to make more exact studies of the gastric movements in man.

Cannon (31) has found that after an ordinary full meal to which was added bismuth

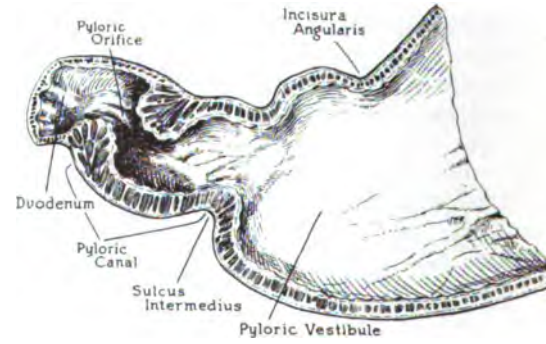



Fig. 2. Section through the pyloric end of the stomach of a woman 26 years old in the plane of the two curvatures.

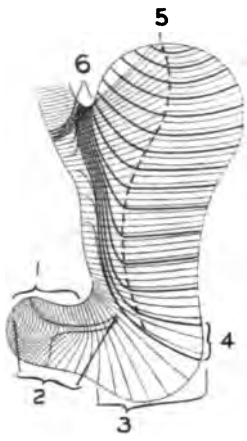



Fig. 3.

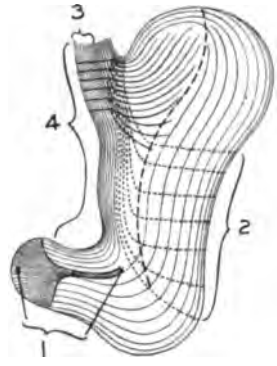



Fig. 4.

Fig. 3. Diagram of the circular and oblique layer. 1, circular musculature of the pyloric canal; 2, ligamentum ventriculi; 3, fan-shaped musculature of pyloric vestibule; 4, lower segmenta sling; 5, line of insertion of the oblique musculature; 6, supporting sling. Fine lines, circular muscle (after Forsell). Heavy lines, oblique muscle.

Fig. 4. Diagram of the longitudinal muscular layer of the stomach (after Forsell). 1, ligamentum ventriculi; 2, body of the stomach; 3, median longitudinal bundle; 4, median longitudinal bundle. Oblique muscle of the corpus, dotted lines.

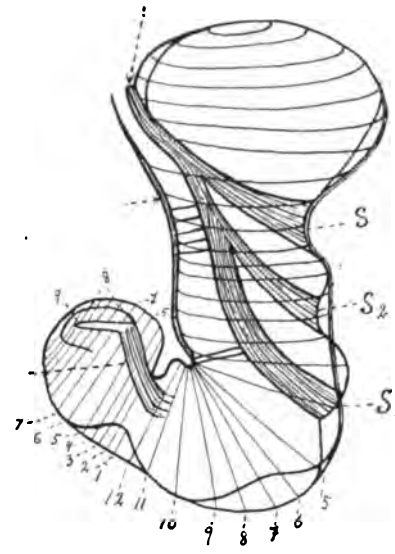



Fig. 5. Scheme showing the modus operandi of some of the muscle fibers (after Forsell).

subnitrate, a slight annular constriction shortly appears near the beginning of the vestibule, which moves slowly toward the pylorus, and later similarly moving constrictions appear near the middle of the stomach. The waves become deeper on the vestibule. The food is held quietly without being mixed in the cardiac part, where the surface layer of food comes in contact with the acid-secreting walls. The ptyalin digestion may thus go on in the center for an hour or more. There is no peristalsis on the cardiac end of the stomach, but this part gradually contracts upon its contents, pressing the acidified layer into the active pyloric part, where in the vestibule it is churned and thoroughly mixed with the gastric secretions by the deep peristaltic waves until the chyme is ready to be expelled into the duodenum (Fig. 7). Acid is not secreted in the pyloric part, while pepsin is. The con-

Fig. 6. Interior view of sulcus salivalis of Retzius in a contracted stomach of a dog (after Kaufmann).

Fig. 7. (After Cannon.)

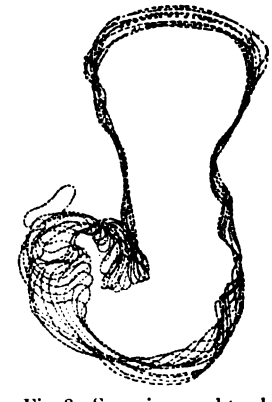


Fig. 8. Superimposed twelve phases of a single contraction of a normal stomach in man (after Kaestle, Rieder and Rosenthal).

tents of the vestibule is expelled at intervals depending upon the condition of the chyme and the acidity on both sides of the pylorus.

The pylorus obeys the so-called "law of the intestines": the acid, when above, causes a relaxation of the sphincter, which is below; and the acid, when below, causes a contraction of the sphincter which is above.

Kaestle, Rieder, and Rosenthal (32) succeeded in taking series of instantaneous radiographs of the movements of the stomach in man. They hold the same view as Cannon, that normally, during digestion, there is no complete separation by a contracting transverse band between the pyloric portion and the rest of the stomach, as maintained by the older physiologists (Fig. 8).

Hertz (33) says that in his X-ray work he has several times seen complete separation, and likewise Kaufmann and Holzknecht (92).

In vomiting the complete contraction has been observed by Cannon. The experiments of Cannon were mainly conducted on animals. The question as to the movements of the human stomach has not been definitely settled yet.

In a recent work Groedel (34), who himself has made extensive investigation, says that there has not yet been sufficient time to arrive at definite conclusions.

### ETIOLOGY

Cruveilhier (35) gave a good description of functional pyloric stenosis, and he related a case observed by him in 1822, in which the pylorus was found perfectly normal at post-mortem.

It was due to the teaching of Kussmaul (36–37), however, that the importance of the spastic disturbances of the motility of the stomach secondary to organic lesions became better known, and a number of cases have been reported since then. Doyen (38), Carle and Fantino (39), Schirokauer (40), and others have reported such cases operated upon.

The importance of this has been particularly evident of late, since Haudek (41) by his X-ray work was able to show that almost every case of florid gastric ulcer was accompanied by disturbance of motility due to spasm of the pylorus. The pyloric end, the cardia, and the body of the stomach are the parts most frequently affected by spastic contraction.

Gastrospasm, in which the entire organ participates, is said to exist, but Langemak (42) found no case reported up to 1902. Waldvogel (43), on the other hand, thinks gastrospasm a rather frequent occurrence, and Schwarz (44) has recently demonstrated gastrospasm in two cases by the aid of the X-rays. Boas (45) has described, under the name "Magensteifung," spasm of the body of the stomach.

Spastic contraction of the pyloric end is said to be reflexly caused by ulcer, erosion, cicatrix, adhesions, new growth, inflammation, hyperacidity, stagnation of food, foreign body, and the Landerer-Maier (46) type of congenital pyloric stenosis.

Spasm due to primary motor neurosis has been denied by some; but on the other hand it has been argued that if the existence of pyloric insufficiency is admitted, idiopathic spasm of the pylorus should also be. Furthermore, there is no question that we have an analogous condition in the cardiac end of the œsophagus — the so-called cardiospasm.

Riegel (47) says that before we are justified in considering the spasm of the pylorus as a genuine primary motor neurosis we must be able to exclude all perversions of gastric secretions, mechanical obstacles in the pyloric region, all adhesions, cicatrices, etc.

CASE 1. Spastic tumor of the pyloric canal. Resection, Billroth 2nd. Farmer's wife, aged 39; five children. She was operated upon for vesico-vaginal fistula and cervical laceration five years previous to the onset of the present trouble; had hay fever for three seasons; has complained of ache in the small of the back for a year. For three months the patient had had a burning sensation and rumbling in the stomach, with dull ache and sharp pains shooting to the back and down the sides of the abdomen. She had noticed a lump in the epigastrium.

*Examination.* Heart and lungs normal; upper pole of right kidney palpable; uterus retroverted; hæmorrhoids. The abdominal walls were thin and somewhat above the umbilicus was seen a prominence which measured about 6 cm. by 4 cm. The tumor was hard and somewhat irregular and not very sensitive. Gas could be felt bubbling through it. It was perfectly movable. On inflating the stomach with air the tumor slipped to the right of the midline and the greater curvature was about 2–3 fingerbreadths below the umbilicus. Gastric peri-

stalsis was seen. There had been no vomiting. No dilatation. Fasting stomach, empty. After test-meal, 75 ccm.; acid to litmus; no congo-reaction. The tumor was examined and measured several days in succession, and it was always present and of the same size, contour, and consistency. Repeated test-meals showed absence of hydrochloric acid.

*Diagnosis.* Tumor of pylorus, most likely carcinoma.

*Laparotomy.* The tumor, which measured about 4 by 3 cm. and was hard as cartilage, disappeared while being examined. A thickening remained in the upper wall near the pylorus, which was patent, and resection of the stomach with a posterior gastro-enterostomy was made.

The patient made a prompt recovery and has had no trouble with her stomach since the operation, which was performed three years ago.

Examination of the specimen showed that even the thickening in the upper part of the wall had disappeared, and there is no scar, ulceration, or tumefaction; it appears to be perfectly normal (Fig. 9). The part involved by the spastic tumor was the pyloric canal. The pylorus itself was unaffected.

Few cases of the spastic tumor of the pyloric end in the adult have been reported. Poensgen (48), who examined the literature from the earliest times down to 1882 on the question "the motor functions of the stomach and their disturbances," even doubted that such a tumor could be possible. In infants, however, a number of cases have been reported since Hirschsprung (49) in 1887 demonstrated specimens and described cases under the name "congenital stenosis of the pylorus." Further investigation has shown that there may be two distinct types — a true organic stenosis, as described by Landerer-Maier (46) in adults, and a spastic contraction of the pylorus: Ibrahim (50), Pfaundler (51), Koplik (52), and Wernstedt (53). The latter examined Hirschsprung's old specimens and found that they belonged to the spastic type, and he says that so far no specimen from an infant has been described that belonged to the Landerer-Maier type, so that probably the majority of the cases reported are of the spastic type. As pointed out by Wernstedt, the mucosa must show an abnormal narrowness in order to prove it congenital.

In two recent cases reported by Rammstedt (54), the evidence of pyloric obstruction commenced respectively five and two weeks after birth. In both cases he made a longitudinal incision of the pyloric tumor down to but not through the mucosa. In the first case he tried to unite the cut muscular wall of the pylorus transversely, but the sutures cut through. In the second case no union was attempted. Both cases were cured. The contracted muscular wall formed a hard tumor 2 cm. long. These two cases seem quite analogous to my Case 1, and could well be interpreted as post-natal spasm.

Scudder (93) cites a case of Koplik's in which, two years after a gastro-enterostomy for obstructive pyloric tumor in an infant, there was recurrence of the vomiting. Scudder regards this as evidence that the pyloric tumor persists and that the stoma is closing. I think that if the stoma is closing it would be evidence that the obstructing pyloric tumor had disappeared after the gastro-enterostomy was made, and that the pylorus had resumed its proper function, thus permitting the stoma to close. The vomiting would therefore indicate "recurrence" of the pyloric obstruction and not that it had persisted. It seems to me that this case rather furnishes evidence that some of the hard obstructive tumors in infants are simply spastic contractions that disappear when the pylorus is functionally excluded. It is probable that the part involved in such cases is the pyloric canal.

Doyen (55) expressed himself to the effect that the pylorus is the dominating factor in the pathology of the stomach, i.e., through the spasm.

The rôle played by the pyloric canal under similar circumstances is not known, but physiologically it is apparently a very active part, and is perhaps often implicated or independently disturbed. As Cunningham puts it, that it has an important action cannot be doubted; its powerful musculature bespeaks the fact. He also expressed the opinion that the musculature of the pyloric canal acts to some extent independent of that of the rest of the stomach, and is under the control of a special nervous mechanism.

According to Forsell (12) the pyloric canal is the apparatus concerned in regulating the

evacuation of the vestibular contents. Cannon says that "at all times (during digestion) in the close neighborhood of the pyloric canal the circular and longitudinal muscles, both of which are strongly developed, probably cooperate to decrease simultaneously in all directions the terminal segment of the stomach."

It seems to me that there is considerable resemblance in the functional activity of the pyloric canal and the epicardia or the lower 4-5 cm. of the œsophagus. Through the œsophagoscope I have seen the epicardia in spastic contraction in a number of cases (56). The only demonstrable abnormal condition about the stomach in Case 1 is the absence of hydrochloric acid, and the question is, may that be the cause of the spasm?

It has been shown by Hedblom and Cannon (57) that hyperacidity retards the passage of food from the stomach, and Katschowski (58) found that after double vagotomy in one dog a gastric juice of 0.7 to 0.8 per cent of hydrochloric acid produced pyloric spasm; in another the spasm was very strong and lasting with an acidity of 0.676 per cent. On the other hand, it is well known that the food, in case of achylia gastrica, may be rapidly expelled from the stomach.

As mentioned above, the longitudinal muscle fibers of the pylorus constitute the "dilatator," and some of these fibers are continuous with those of the duodenum. In case of achylia gastrica the duodenal contents remaining alkaline during digestion would be a constant stimulus to the longitudinal fibers to open the pylorus, while the absence of acid in the pyloric vestibule would have a tendency to keep the pylorus closed, thus upsetting the equilibrium, though ordinarily the pyloric mechanism adapts itself to conditions. However, as achylia gastrica is of relatively common occurrence and spastic tumors of the pyloric canal are very rare, there must be another etiologic factor, so that the explanation herein attempted would hardly suffice. I think that the case must be classified as one of primary motor neurosis. Apparently the balance between the two sets of fibers had been fairly well maintained in my case, as the canal was always patulous and there was never stagnation of gastric contents.

Leg (59), examining a somewhat limited number of cases of achylia gastrica, could not demonstrate hypermotility.

In the table which I have prepared of eleven cases (operated upon) of spastic pyloric tumors found in the literature, together with my own case, will be seen the varying degrees of acidity, and it also shows that the cases with subnormal acidity are in preponderance.

### TREATMENT

Pyloroplasty would seem to be the ideal operation in cases of this kind, but Schnitzler had recurrence in his case, which is included in the accompanying table, and likewise in another case of pyloric spasm secondary to ulcer, which he reported in the same paper.

In the case of Brunner's, where hyperacidity was considered the etiologic factor, there was recurrence after gastro-enterostomy. According to Cannon and Blake (67), Kelling (68), Berg (69), and others, the food will pass through the pylorus, if this is patulous, rather than through a gastro-enterostomy opening; hence the failure of gastro-enterostomy unless the pylorus is simultaneously occluded. The necessity of permanent occlusion of the pylorus in such a case is further emphasized by the experiments of Jianu and Grossman (70), who found that if gastro-enterostomy alone was performed there would be no change in the acidity, while if the pylorus was simultaneously occluded there was a marked diminution in the secretion of acid.

Recent experiments of von Tappeiner (71), however, have shown that there is no method of sewing or tying the pylorus that will keep it permanently closed, except that of Wilms (72), who sewed a strip cut from the anterior sheet of the rectus fascia around the pylorus, a method which I have used in Case 2.

The results in the five cases where resection was performed were so uniformly good that the operation seems justifiable (resecting the part involved), but the *exclusio pylori*, whereby the pyloric end of the stomach is cut through and the stumps separately closed, followed by gastro-enterostomy, as first done by Doyen and later by von Eiselsberg (73), may perhaps accomplish the same result.

| By whom reported. | Sex. | Age. | Chief symptoms. | Hydrochloric acid. | Diagnosis before operation. | Pathologic conditions at operation. | Kind of operation. | Result. Remarks. |
|---|---|---|---|---|---|---|---|---|
| Schnitzler (60) | F | 35 | Epigastric pain radiating to back. Vomiting. Tumor. | Not examined | Carcinoma | Spastic tumor; otherwise normal | Pyloroplasty | Recurrence in one year, then gastro-enterostomy. Cure. S. thought it motor neurosis. |
| Carle and Fantino (39) | M | 25 | Epigastric pain. Vomiting. Tumor. | High | Fibrous stenois | Slight pyloric hypertrophy; otherwise normal | Pyloroplasty | Cure. |
| Carle and Fantino | F | 51 | Epigastric pain. Vomiting. Tumor. | Trace | Carcinoma | Cicatrix near pylorus | Divulsion after Hahn | Improved. |
| Alberti (61) | M | 52 | Epigastric pain. Vomiting. | High | Pyloric stenosis | Spastic tumor; otherwise normal | Pyloroplasty | Cure. |
| Brunner (62) | F | 32 | Epigastric pain. Vomiting. | High | | Spastic tumor; otherwise normal | Posterior gastro-enterostomy | Recurrence a few days after operation. |
| Schloffer (63) | F | 44 | Diarrhœa for 5 months, then epigastric pain. Vomiting. Tumor. | Absent | Probable carcinoma | Spastic tumor; otherwise normal | Resection ant. gastro-enterostomy | Cure. The tumor was hard and circumscribed, 1x2 cm., and confined to one side. |
| Dauwe (64) | F | 63 | Stomach trouble for years; repeated hæmatemesis. Vomiting. Tumor. | Absent | Probable carcinoma | Pylorus patulous, slightly indurated, adherent to pancreas | Pylorectomy, Billroth's 1st | Cure. |
| Venot (65) | M | 47 | Burning pain. No vomiting. Tumor. | Present | | Two cicatrices the size of a grain of corn near pylorus. Pylorus somewhat contracted | Pyloroplasty | Cure. |
| Manasse (66) | M | 42 | Epigastric pain radiating to the back. Vomiting. Tumor. | Subnormal | Probable pylorospasm with ulcer. Cancer not excluded | Varicose veins about pylorus; otherwise normal | Pylorectomy, Billroth's 1st | Cure. |
| Manasse | F | 55 | Epigastric pain. Vomiting. Tumor. | Trace | Probable pylorospasm with cancer | Myoma size of a pea near pylorus; otherwise normal | Pylorectomy, Billroth's 1st | Cure. |
| v. Bergmann (104) | F | 32 | Typical ulcus pain; occult blood in fæces. Tumor. | Not mentioned | Probable carcinoma | Spastic tumor, large ulcer | Resection | Result not mentioned. |
| Lerche | F | 39 | Burning sensation and sharp epigastric pain shooting to the back. No vomiting. Tumor. | Absent | Probable carcinoma | Spastic tumor; otherwise normal except for a thickening in upper wall, absent in specimen | Resection Billroth's 2d | Cure. |

CASE 2. Spasm of the pyloric sphincter. Posterior gastro-enterostomy; closure of the pylorus by sewing a strip of the rectus fascia around it. Female, unmarried, aged 25. The patient stated that her whole family had weak stomachs and were nervous. In childhood she had attacks of vomiting, accompanied by the sensation of distention of the stomach, as if there were a tight band around the waist. She was anæmic in her school-days and had stomach trouble, for which she took soda. She always had to be careful about eating, and never could take butter, cream, etc., and whatever she did eat she could only take in small quantities. There had been several light attacks of pain in the right fossa iliaca. Since November, 1911, her stomach had been particularly bad, and she complained of distress after eating, and belching of gas; frontal headaches, which were relieved on taking soda; constipation, bad taste in the mouth, and a very much coated tongue; at times pain in the epigastrium. In the first part of January, 1912, she had a tooth extracted under chloroform anæsthesia, after which she vomited for a week, and had to stay in bed for a month. After this she was on a diet of peptonized milk, eggs, and scraped beef for almost seven months, but without any relief. She could only take small quantities of any kind of food, and she nearly always felt nauseated after eating; at times she vomited. She had much gas on the bowels. The patient frequently used an enema, which always made her feel nauseated. She could not take cold water.

*Examination.* Chest and pelvic organs negative; slight tenderness in right fossa iliaca; at times sensitive to pressure in the epigastrium, but at no certain point. Urine, negative. Fasting stomach, empty. After test-breakfast, 150 ccm.; total acidity, 80; free

hydrochloric acid, 45. After another test-breakfast, 300 ccm.; total acidity, 50; free hydrochloric acid, 25. A radiograph taken six hours after a Rieder meal showed considerable stagnation (Fig. 10). The outline of the stomach immediately after the meal is seen in Fig. 11. Ulcus diet and rest in bed were tried, without the slightest relief.

*Diagnosis.* Possibly ulcer or adhesions causing pylorospasm. Present weight, 85 lbs.

*Laparotomy.* There was no evidence of ulcer or scar on the stomach or duodenum. The pyloric sphincter was spastically closed; the gall-bladder normal. Posterior gastro-enterostomy was made and the pylorus occluded by sewing a strip from the rectus fascia around it, as advocated by Wilms. Appendectomy.

During the operation I examined the pylorus several times; on one examination only did the pylorus open, and it then suddenly "flew open," so to speak, while I held the firmly contracted sphincter between my thumb and forefinger. It then fairly readily admitted the tip of the forefinger, although it may have been a trifle smaller than normal, due perhaps to hypertrophy of the sphincter. This phenomenon of sudden relaxation of the spasm I have observed through the œsophagoscope once in the cardial end of the œsophagus, in the case of a young lady who had been treated for gastric ulcer, with rest in bed, etc., for three weeks, and during a similar previous attack for seven weeks without any relief whatever. The trouble disappeared within a few days under the administration of atropine.

The absence in Case 2 of any particular point in the epigastrium sensitive to pressure, and the absolute lack of response to medical treatment with rest in bed, etc., was not in favor of diagnosis of gastric ulcer. The remarkable repugnance to fat in any form would have suggested that possibly the gall-bladder might be at fault, causing pyloric adhesions and spasm.

With a history of digestive disturbances of so long standing one could expect to find some evidence if there had been any organic lesion, although positive absence of a lesion could, of course, only have been determined by intragastric inspection.

The case seemed, therefore, likely to be one of primary motor neurosis. The tongue, which before the operation was swollen, beefy red, and glazed, became normal in appearance. The patient became very fond of butter.

CASE 3. Acute pylorospasm and chronic cardiospasm. Posterior gastro-enterostomy; stretching of the cardiac end of the œsophagus. Male, aged 36. Was well up to the age of 27, when he commenced to have difficulty in swallowing, which developed into a typical case of chronic cardiospasm. Five weeks before coming under my care he was taken suddenly ill with violent cramp in the epigastrium. He tried to vomit but could not. Large doses of morphine did not relieve. The man was desperately ill, and his physician referred him to Dr. Lundholm of St. Paul for operation, 48 hours after the onset. The temperature was subnormal; the abdomen was distended, tense, and tympanitic.

Laparotomy performed by Dr. Lundholm revealed an enormously distended tympanitic stomach. The stomach was punctured with a trocar but did not collapse, and an incision was therefore made in the wall of the stomach, after which the organ gradually collapsed. The duodenum was not distended, there was only a small quantity of fluid in the stomach, and nothing else abnormal was found. The incision was closed. Two weeks later the patient had another similar attack and a posterior gastro-enterostomy was made, which relieved the stomach. The cardiospasm, however, now caused him the greatest difficulty; he could hardly get any food into his stomach, and his weight became reduced to 110 pounds.

At this juncture Dr. Lundholm kindly referred the case to me for examination and treatment of the œsophagus. Total gastric acidity 30. Congo-reaction positive. Œsophagoscopic examination revealed a greatly dilated œsophagus and the epicardia in spastic contraction. The epicardia-cardia was stretched. When the patient was re-examined three months later he had gained 44 pounds in weight. Nearly two years after operation the patient informed me that he had had no trouble with his stomach, but coarse vegetables would occasionally pass his œsophagus more slowly than normal; otherwise he was well. I think that there had been a primary atony of the œsophageal wall, with the cardiospasm secondary.

This is an unusual combination — chronic cardiospasm and acute pylorospasm. I have not been able to find a similar case in the literature except the following, reported by Beardsley (74) in 1788. A child commenced to vomit during the first week after birth and kept it up more or less until its death at the age of five years. Beardsley, who first saw the boy when he was two years old, and who made the post-mortem, said that it did not appear that the boy was attended with

nausea or sickness at his stomach, but he often complained that he was choked, and of his own accord would introduce his finger in order to vomit and relieve the choking. He would take large draughts, which at times would become immediately ejected. Autopsy showed a greatly dilated œsophagus, in the walls of which were vesicles or diverticula containing fluid. The stomach was unusually large and contained fluid similar to that found in the œsophagus. The pylorus was hard and contracted. This case of Beardsley's has later been described as a case of "hypertrophic pyloric stenosis." To judge from the post-mortem findings in the œsophagus and the peculiar history of choking without nausea and the taking of large draughts (very likely to force down the stagnating œsophageal contents), there has also been an obstruction at the cardiac end of the œsophagus. In view of what has been said earlier in this paper in regard to the pyloric stenosis in infants, the case might be interpreted as one of chronic pylorospasm and chronic cardiospasm.

There was no evidence of gastric lesion in Case 3, and the cause of the pyloric spasm cannot be positively determined.

Von Openchowsky found that the cortical center for the opening of the cardia is also the center for the contraction of the pylorus.

In Case 3 both ends of the stomach were contracted. Œsophagoscopy showed the œsophagus very much dilated, and the walls gave the impression of being hypertrophied and rigid. Just above the diaphragm to the right the œsophageal wall was especially dilated so as to form a shallow pocket. It is possible that secondary periœsophageal changes had taken place in this neighborhood, which by irritation of the vagus have caused the pyloric spasm.

The following case of Hochenegg's (97) shows the effect of injury to the vagus nerves. A revolver bullet penetrated the thorax of a young girl, producing vomiting, pylorospasm, and enormous distention of the stomach. She made a complete recovery after a gastrostomy which was permitted to close in a few weeks. The conclusion was: some intrathoracic lesion to the vagus or branches.

That inflammatory exudate may disturb the vagus was seen in a case of Küttner's (98). Five days after thoracoplasty for empyema, cough and uncontrollable vomiting set in. Necropsy showed the left vagus embedded in dense pleural exudate and a greatly dilated stomach. Fritsch (99) attributed the cough, vomiting, and dilatation of the stomach to the irritation of the vagus. My interpretation of Case 3 is that there was a primary atony of the œsophagus with secondary spasm of the cardiac end, followed by dilatation of the œsophagus. Whether similar changes took place in the stomach, or whether the acute pylorospasm with gastric dilatation was a result of a periœsophageal irritation to the vagus, there is no way of determining. Gastro-enterostomy would naturally be the operation of choice in this case, with occlusion of the pylorus.

CASE 4. Female, 31 years old; married; never pregnant. Since the age of 15 years the patient occasionally felt a pain about the umbilicus that compelled her to bend forward in order to get relief. She says that it felt as if something pulled, as if something were too short. At times the pain would be absent for two or three months, but then again she might have several attacks in a week.

She had not felt this particular pain for the last seven months previous to consultation. About seven months before I saw the patient she had an attack of pain to the right of and on a level with the umbilicus, which lasted for a day; no vomiting nor fever. A month later she had a similar attack, with which she stayed in bed for a week. Since then she has had more or less pain to the right of the umbilicus, sometimes more pronounced on walking and on turning in bed.

For the last nine years the patient had been distressed after eating, and quite frequently she had a cramp or dull ache in the epigastrium. No treatment or diet had given her any relief. Bowels irregular, moving every two or three days without physic.

A diagnosis of appendicitis had been made and operation had been advised.

For three weeks previous to consultation the patient had been in bed with an attack of diarrhœa.

*Examination.* A tall, thin woman, stoop-shouldered, and with long, flat chest. Chest and pelvic organs normal. Abdominal wall somewhat rigid and drawn in. Some tenderness to the right of the umbilicus. Temperature and pulse normal. Fasting stomach, empty. After test-breakfast, 20 ccm. of alkaline reaction. No trace of hydrochloric acid after several test meals. Radiograph six hours after a bismuth meal, empty. First radiograph a

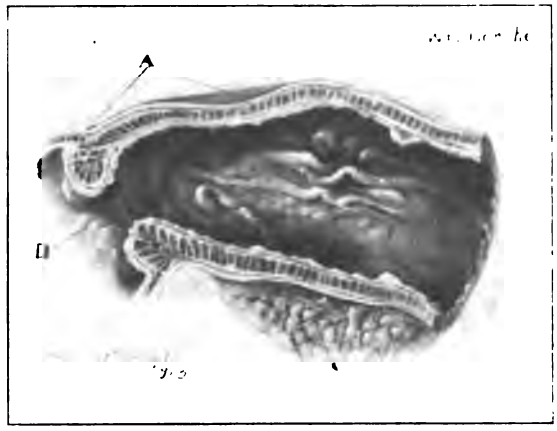



Fig. 9. Resected specimen from Case 1. A, pyloric canal; D, duodenum.

Fig. 10. Case 2. Six hours after a bismuth meal.

Fig. 11. Case 2. Immediately after a bismuth meal.

Fig. 12. First radiograph taken a few minutes after a bismuth meal.

Fig. 13. Second radiograph taken a few minutes after a bismuth meal two weeks after the first.

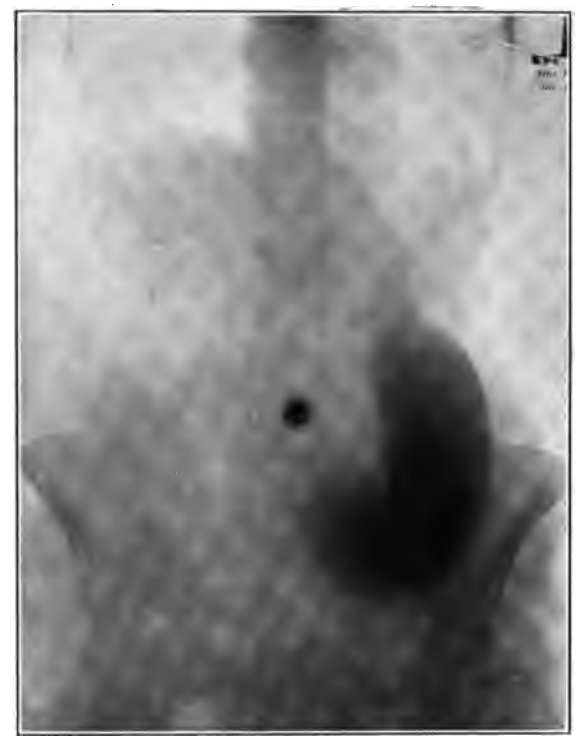


Fig. 14. Third radiograph taken a few minutes after a bismuth meal. Six weeks after operation.

few minutes after a bismuth meal, hour-glass contraction at the vestibule (Fig. 12). Second radiograph a few minutes after a bismuth meal, taken two weeks later, showed a still more pronounced hour-glass contraction of the vestibule (Fig. 13).

*Diagnosis.* Spastic hour-glass stomach, possibly due to adhesion.

*Operation.* Through an incision through the right rectus muscle, the stomach and duodenum were examined and no scar, ulcer, or any other pathologic condition found. The antrum of the duodenum seemed to be unusually large. The appendix, small but apparently perfectly healthy, was removed. On sweeping the finger under the abdominal wall a tumor was found projecting from under the umbilicus. On turning this part of the inside of the abdominal wall up, a white tumor was seen subperitoneally directly under the umbilicus. The tumor, measuring about 2.5 cm. at its base and projecting about 2.5 cm. into the abdominal cavity, was removed and found to consist of a sac containing putty-like material and hair — a dermoid cyst. The abdomen was closed. A few days later there was evidence of pus in the abdominal wall. The incision was reopened barely sufficient to insert a small gutta-percha tissue drain, and the pus tract was found to lead to the former bed of the tumor.

The patient told me that for several months she had now and then noticed small quantities of a whitish material come from her umbilicus, so the cyst may have been infected through the umbilicus.

The patient has felt well since the operation, has had no distress or cramps after eating, and has gained in weight.

A third radiograph a few minutes after a bismuth meal, taken six weeks after the operation, does not show any hour-glass contraction of the stomach (Fig. 14).

The question is, Has the tumor had anything to do with the motor disturbances of the stomach? The patient was very thin, and the tumor probably came in contact with the first part of the duodenum, and the direct pressure may possibly have caused the hyperkinesis of the stomach by irritating the duodenum.

CASE 5. Probably cicatrix from gastric ulcer with hour-glass stomach, spastic or combined spastic and organic. Female, aged 41; six children. Mother died from cancer of the stomach. Menstruation at 14. About this age she was pale, weak, and had a gnawing pain in the stomach when it was empty. Sometimes she had pain right after eating, at times

Fig. 15. Radiograph of the stomach in the horizontal position of Case 4 about ten minutes after a bismuth meal. Note tube in the stomach.

half an hour after. She had been bothered with her stomach in this way ever since. She rarely vomited, but at times gulped up food. The pain was felt on the left side toward the costal arch; she had passed bloody urine for some time.

*Examination.* Patient was very anæmic. A sensitive spot toward the left costal arch. On catheterization of the ureters the blood was found to come entirely from left kidney. Fasting stomach contained some meat and vegetables that she had taken 24 hours previously. On two subsequent examinations the fasting stomach was found to contain food. Several test-meals showed absence of hydrochloric acid.

On inflating the stomach with air and letting it out, there would be a gush of air, after the bulk of it had passed off, by pressing on a prominent part above the umbilicus. The same was observed when water was poured into the stomach. The experiment was repeated a number of times at each sitting. At this period the patient was distressed. The following week the patient was feeling well, and repeated washings of the stomach failed to show any stagnation of food; the above mentioned phenomenon could not be elicited.

With the history of gastric ulcer and with the findings mentioned I suspected a spastic hour-glass stomach, and a few days later, when the stomach again distressed her, I had two radiographs taken. One picture (Fig. 15) was taken in a horizontal position ten minutes after a bismuth meal, with a lavage tube in the stomach. The rubber tube can be readily seen hugging the lesser curvature or the upper part of the canal of Retzius until it seems to stop in a niche. The fundus appears balloon-like to the left, as it is usually seen when radiographed in the horizontal position.

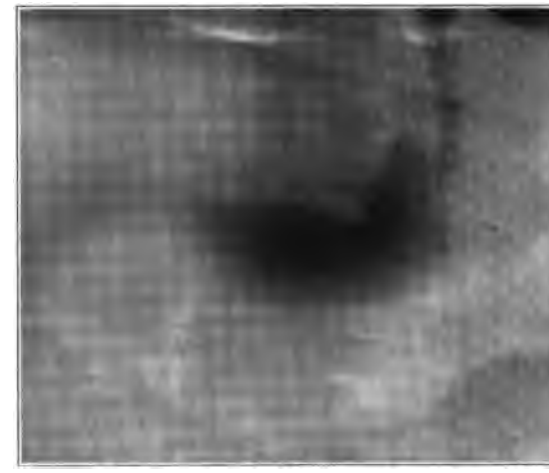


Fig. 16. Radiograph of stomach in Case 4. Taken in the upright position. One hour after a bismuth meal.

The second picture (Fig. 16) is taken in the erect position, one hour after a bismuth meal. The fundus is seen sagging down in the upper left corner, and the greater curvature is pulled sharply up toward the lesser. The cardiac part is connected with the pyloric part by a narrow streak of bismuth. The peculiar shape of the lesser curvature will be noted.

I thought that this peculiar form of the lesser curvature might possibly be due to an exaggerated contraction of the oblique fibers forming the sulcus salivalis or canal of Retzius so graphically described by Gyllenskoeld (loc. cit.). This canal may be of great functional importance. Cohenheim (75), experimenting on dogs with duodenal fistulæ, found that if the dog was allowed to drink water or a salt solution after a meal while the stomach was full, the water would appear in quick spurts and almost clear and unmixed with acid at the pylorus; it had passed along the canal of Retzius.

Fig. 17.

Fig. 18.

Pebbles causing pyloric spasm.

Professor Ernest, in discussing this paper of Cohenheim's, said that in people who had swallowed corrosive fluids in small quantities he had invariably found the destruction along the lesser curvature at post-mortem. What relation the function of this canal has to the pathology of the stomach remains to be seen, but we know that the largest percentage of cancer and ulcer of the stomach occur along this tract — the pylorus, the lesser curvature, and the cardia.

*Diagnosis.* Ulcer or cicatrix on the lesser curvature in the upper half, possibly with perigastric adhesions, but spastic hour-glass contraction alone likely on the basis of cicatricial contraction.

In order to verify a diagnosis of spastic hour-glass stomach it would be necessary to take two or more radiographs at different times.

Operation was postponed on account of hæmaturia.

Hour-glass stomachs are usually divided into the congenital and acquired. Rieder (76) says that very few cases of congenital hour-glass stomach have been reported in German literature, and Cunningham (loc. cit.) and Moynihan (77) both deny the existence of this form.

The acquired hour-glass stomach may be caused by (1) cicatrix from ulcer or corrosives, (2) perigastric adhesions, (3) tumor, (4) spasm and (5) tight lacing is given as a cause by some.

Budinger (78) reported a case in which at operation he observed a spastic contraction of the stomach at the junction of the vestibule with the body. The contracted portion was 4 cm. long and very firm. It disappeared suddenly and reappeared. There were also a few adhesions and a small cicatrix. Schmitt (79) has observed similar spastic contractions at operation.

Since the X-rays came into use in the examination of the stomach, a number of cases of spastic hour-glass stomach, mostly secondary to ulcer, cicatrix, or cancer, have been reported by Rieder (76), Baron and Barsony (80), Haudek (81), Jolasse (82), von Schmieden (83), Stierlin (84), de Quervain (85), Härtel (86), Perthes (87), Hertz (88), and Faulhaber (89).

The importance of the use of radiography in the diagnosis of diseases of the stomach has been well demonstrated by Clairmont and Haudek (90). Of 200 cases in which they had used the X-rays for diagnosis, more than one-third were operated upon, and it was found that no serious mistake in diagnosis had been made.

Stiller (91) claims that the radiograph of the stomach obtained after a bismuth meal is artificial and not a true expression of the real form, but he seems to be the only one of that opinion.

The test of Holzknecht and Fujinami (94), by letting the patient drink a certain quantity of water and take a pair of Kaestle's capsules, after which the length of time this remains in the stomach is ascertained by the aid of the X-rays, may be of value in differentiating between spastic and organic obstruction.

CASE 6. Pylorospasm caused by foreign bodies. Female, aged 16; a native of Vienna, where she lived until the age of 14 years. At the age of 8 years she swallowed 48 pebbles, imitating a performer that she had seen in the circus. The following day she had much pain in the stomach but she did not vomit. She was taken to the hospital (Allgem. Krankenhaus, Vienna, Med. 3), where she stayed for two months. She said that operation was advised but refused by her people. Since then she has had periodical attacks of violent pain, vomiting, and epigastric distention. She said that her stomach would stand out like a football, which was verified by the attending physician. The vomitus was bitter and of yellow color, but only when she had taken anything into the stomach. The bowels did not move during attacks. The last attack was unusually long, having lasted a week.

*Examination.* A bulging was seen in the epigastrium, which was very tense and sensitive to touch and proved to be the stomach. X-ray examination was advised but refused. She had had four attacks during the last year.

The patient was taken to the hospital, and preparatory to the operation a dose of castor oil was administered, with the result that two pebbles were found in the stools (Figs. 17 and 18). They measured 14x17x10 mm. and 22x15x9 mm. and were quite smooth. Although the patient was feeling quite well a laparotomy was decided upon for the following reasons: Taking it for granted that the patient's history was correct, it seemed to me that the pebbles were rather small to cause so much trouble, because incredibly large foreign bodies are known to have passed the pylorus. An abnormal narrowness of the pylorus or adhesions were therefore thought to have excited the pylorus to spasm.

At the operation a careful examination of the

stomach and bowels failed to disclose anything abnormal, and the abdomen was closed. The patient has had no trouble with her stomach since the operation two and one-half years ago.

One may be reasonably sure that the comparatively small pebbles had caused the severe pylorospasms that the patient suffered from for eight years.

Disturbance in the gastric nervous apparatus is responsible for the spasms, and the cause of this disturbance may either be an organic lesion of the stomach, as in Case 5, which is the most frequent; irritating foreign bodies, as in Case 6; or there may be no demonstrable lesion, as in Cases 1 and 2, the so-called idiopathic spasm. The pylorospasm in Case 3 is very likely idiopathic, but an intrathoracic irritation of the vagus cannot positively be excluded.

It has been quite commonly assumed that hypersecretion or hyperacidity causes pylorospasm, but no evidence has been brought forth to verify the correctness of this.

As mentioned above, Katschowsky found that a gastric acidity of 0.7 to 0.8 caused pylorospasm in dogs upon which he had made double intrathoracic vagotomy. By treating them with soda and milk diet whenever the acidity was above 0.4, he prevented the pylorospasms.

Fritsch (99) in his experiments did not treat his vagotomized dogs with soda to regulate the acidity, and all the animals that lived for some days after operation had greatly dilated stomachs at the time of death. These experiments would seemingly demonstrate that high acidity causes pylorospasm. On the other hand Friedenthal (100), in a dog, cut off both vagus nerves above the diaphragm and nervi splanchnici on both sides. Six weeks later he removed the spinal cord below the fifth thoracic vertebra. The dog had no digestive disturbances and remained well up to two weeks after the last operation, when he died from meningitis. Hedblom and Cannon found that on feeding potato acidified to 0.25 per cent with hydrochloric acid to healthy cats, it left the stomach faster than normal, while if acidified to 1 per cent it left the stomach more slowly than normal. Although these investigators, by the aid of the X-rays, demonstrated retardation in the exit of food from the stomach in the presence of high acidity, they did not observe pylorospasm. It may therefore be inferred that with the nerves of the stomach in a normal condition, high acidity per se does not cause pylorospasm.

Engel (96), in a case of pyloric obstruction in an infant, performed jejunostomy, thereby excluding the stomach entirely. In spite of this vomiting persisted until death occurred three weeks after operation. Engel repeatedly demonstrated gastrosuccorrhœa, and concluded that either the latter and the spasm started simultaneously or that the spasm was secondary. It seems more likely that the spasm and the increased acidity are both expressions of the same stimulation of the nerve.

From the cases in the table and other cases in this paper it will be seen that spasm may be present whether the acidity is high, normal, a mere trace, or totally absent. In the majority of the cases in the table the acidity is subnormal or absent, and in a case of spastic tumor of the pylorus recorded by Schütz (95) there was also no hydrochloric acid present.

The vagus and the sympathetic nerves are antagonistic to each other in their regulation of the motor and secretory functions of the stomach, the impulses through the vagus augmenting these functions, while the sympathetic is inhibitory in its action.

Disturbance in the harmony between the two antagonists may give rise to pathologic conditions, and this question has been studied by Eppinger and Hess (101). By subcutaneous injections of pilocarpine and atropine which influence the vagus system, and adrenalin for its effect upon the sympathetic, they studied the symptoms and effect of the variation in the tonus of the two nerve systems.

Their observations led them to believe that every person who reacted strongly to pilocarpine and atropine was insensitive to adrenalin, and vice versa; that persons who showed strong reaction of the sympathicus after adrenalin injection were not sensitive to pilocarpine and atropine and that changes in the two nerve systems could by these means be sharply differentiated. They

pointed out that there are cases with permanently increased tonus of the vagus nerve, and they observed that gastric ulcer is a strikingly frequent occurrence in such cases.

Although Petren and Thorling (102) and also Bauer (103) found that some cases would react to both stimuli, indicating stigmata in both nerve systems, the tests and this field of study inaugurated by Eppinger and Hess promise to become of great clinical value. Von Bergmann (104) says that cases where only one of the nerve systems is affected could hardly occur — they overlap.

Lichtenbelt (105), in his experiments, found that local spasms of the muscularis mucosa of the stomach and first part of duodenum may cause the formation of ulcer by constricting the blood-vessels that pass through it to supply the mucosa; the part thereby made ischæmic is exposed to the digestive influence of the gastric juice. Rössle (106), on the basis of the study of a large post-mortem material, has attempted to show that the gastric and duodenal round ulcer frequently is secondary to disease of some other organ, and is reflexly brought about through the medium of the nervous system in the way explained by Lichtenbelt. Rössle says all observers agree that stimulation of the vagus causes hypertonia of the sphincter pylori, which may extend into a continued spasm. Thus, by the same stimulation of the vagus the vicious circle is complete, i.e., the local spasm of the muscularis mucosa followed by ischæmia, the spastic occlusion of the pylorus, with retention and subsequent autoindigestion of the necrobiotic mucous membrane.

According to the above mentioned authors and other recent writers the nervous system plays a prominent part in the pathology of the stomach, and the local spastic contraction is primary in the production of ulcer, i.e., primary as far as the stomach is concerned.

In a comparatively small group of cases there is spasm of the pyloric end of the stomach or the cardial end of the œsophagus without any demonstrable lesion or apparent cause, and they (Cases 1, 2, and most likely Case 3) are of special interest in this paper. These cases are termed "idiopathic," whereby is meant that there is no evident lesion to account for the spasm in the organ where the spasm occurs; but well may it be secondary to disturbance in another organ, in the sense of Rössle.

Constitutional predisposition is an important factor, and an individual with increased tonus of the vagus or whose vagus system is hyperirritable may react strongly to a slight stimulus.

The visceral nerve systems are in intimate relation with the internal secreting glands. The products of the latter may stimulate or inhibit the vagus or the sympathetic nerves, and the glands, according to Eppinger, Falta and Rüdinger (107), probably only in this way exercise their influence upon the organs.

Pathologic changes in the internal secreting glands may therefore be an etiologic factor in the spasms under consideration in this paper.

## REFERENCES


1. Müller, Erik. Beiträge zur Anatomie des menschlichen Fœtus. Der Königl. schwed. Akad. der Wissenschaften, Stockholm, 1896, Dec. 9.
2. Willis, Thomas. Opera Omnia Amstelædami, 1682 (cit. by E. Müller).
3. Cruveilhier, J. Traité d'Anatomie Descriptive. 1843, Paris, Tome 3.
4. Retzius, A. Bemerkungen über des Antrum pylori beim Menschen, und einigen Thieren. Arch. f. Anat., Physiol. u. wissensch. Med., 1857, 74.
5. Luschka, H. Die Anatomie des Menschen. Tübingen, 1863, vol. ii.
6. Jonnesco, Th. Poirier et Charpy: Traité d'Anatomie Humaine. 4 Tube Digestif. Paris, 1901.
7. Gegenbaur. Lehrbuch der Anatomie des Menschen, 1883.
8. Jonnesco, Th. Traité d'Anatomie Humaine (Poirier et Charpy). Tube digestif. Paris, 1895.
9. Cunningham, D. J. The Varying Form of the Stomach in Man and the Anthropoid Ape. Tr. Roy. Soc. Edinb., 1905–6, 45.
10. His, W. Studien an Gehärteten Leichen über Form und Lagerung des menschlichen Magen. Arch. f. anat. u. physiol. Anat. Abt. 1903.
11. Froriep, A. Über Form und Lage des menschlichen Magen. Verhandl. d. Gesellsch. deutsch. Naturf. u. Ärzte, Leipz., 1906, 78. Versammlung.
12. Forsell, G. Ventrikelrörelserna hos Människan, Nord. med. Ark., 1911, Afd. 1. (Kirurgi). Festskrift for J. Berg, No. 36.
13. Beckey, R. Kontraktionsphänomene des Magens und ihre Beziehungen zur Pathologie. Frankf. Ztschr. f. Pathol., 1910–11, 6–7.
14. Wernstedt, W. Canalis pylori und Vestibulum pylori. Arch. f. anat. u. physiol. Anat. Abt., 1907.
15. Forsell, G. Über die Beziehung der auf den Röntgenbildern hervortretenden Formen menschlichen Magens zur Muskelarchitektur der Magenswand München. med. Wchnschr., 1912, No. 29.

16. Rüdinger. Über die Anordnung der Muskeln im Pförtner des menschlichen Magens. Allg. Wien. med. Ztg., 1879, 24.
17. Gyllenskoeld, O. Über die Fibræ obliquæ in dem Magen. Arch. f. Anat., Physiol. u. wissensch. Med., 1862.
18. Kaufmann, R. Anatomisch-experimentelle Studien über die Magenmuskulature. Ztschr. f. Heilk., 1907–8, Neue Folge.
19. Waldeyer, W. Die Magenstrasse. Sitzungsb. d. könig. preuss. Akad. d. Wissens., Bd. 29, 595–606.
20. Lewis, Frederick T. The Form of the Stomach in Human Embryos; with Notes upon the Nomenclature of the Stomach., Am. J. Anat., 1912, xiii, No. 4.
21. Hasse und Strecker. Der menschliche Magen. Arch. f. Anat. u. Physiol. Anat. Abt., 1905.
22. Cannon, W. B. The Movements of the Stomach Studied by Means of the Röntgen Rays. Am. J. Physiol., 1898, i.
23. Home, E. Lectures on Comparative Anatomy. London, 1814, i.
24. Magendie, F. Elementary Compendium of Physiology. From French by E. Milligan, Philadelphia, 1824.
25. Beaumont. W. The Physiology of Digestion. Burlington, 1847.
26. Hofmeister und Schütz. Über die automatischen Bewegungen des Magens. Arch. f. exper. Path. u. Pharmakol., Leipz., 1885–1886, xx.
27. Rossbach, M. J. Beiträge zur Lehre von der Bewegungen des Magens, Pylorus und Duodenum. Deutsches Arch. f. klin. Med., 1890, 46.
28. von Openchowski. Über die gesammte Innervation des Magens. Deutsche med. Wchnschr., 1889, 35.
29. Roux et Balthazard. Sur l'emploi des rayons de Röntgen pour l'étude de la motricité stomacale. Compt. rend. Soc. de biol., Par., 1897, xlix, 567.
30. Rieder, H. Radiologische Untersuchungen des Magens und Darmes beim lebenden Menschen. München. med. Wchnschr., 1904, 35.
31. Cannon, W. B. The Mechanical Factors of Digestion. Internat. Med. Monographs, 1911.
32. Kaestle, Rieder, Rosenthal. The Bioröntgenography of the Internal Organs. Arch. F. Röntgenray, 1910, No. 119.
33. Hertz, A. F. The Motor Functions of the Stomach. Quart. J. Med., Oxford, 1909–1910, iii.
34. Groedel, F. M. Archiv und Atlas die Magenbewegungen. Ergänzungsband 27, Fortschr. a. d. Geb. d. Röntgenstrahlen, Hamb., 1912.
35. Cruveilhier, J. Traité d'Anatomie Pathologique Générale, Paris, 1852.
36. Kussmaul, A. Über die Behandlung der Magenerweiterung durch eine neue Methode mittelst der Magenpumpe. Deutsches Arch. f. klin. Med., 1869.
37. Kussmaul, A. Die peristaltische Unruhe des Magens nebst Bemerkungen über Tiefstand und Erweiterung desselben, etc. Volkman's Sammlung klin. Vortr. innere Medicin, Nos. 62–92, 181.
38. Doyen. Le spasm du pylore. La Médecine Moderne, 1897, May 29.
39. Carle und Fantino. Beiträge zur Pathologie und Therapie des Magens. Arch. f. klin. Chir., 1898, lvi.
40. Schirokauer, H. Chronisch-recidivirender Pylorospasmus als Indication zur Operation. Berl. klin. Wchnschr., 1904, No. 39.
41. Haudek, M. Radiologische Beiträge zur Diagnostik des Ulcus und Carcinoma ventriculi. München. med. Wchnschr., 1911, 8.
42. Langemak, O. Spastische Erkrangungen des Magendarmtractus. Zentralbl. f. d. Grenzgeb. d. Med. u. Chir., 1902, v.
43. Waldvogel. Vom Gastrospasmus. München. med. Wchnschr., 1911, 2.
44. Schwarz, G. Versuch eines Systems der physiologischen und pathologischen Magenperistaltik. Fortschr. a. d. Geb. d. Röntgenstrahlen; Hamb., 1911, 17.
45. Boas, I. Über Magensteifung. Deutsche med. Wchnschr., 1902, 10.
46. Maier, R. Beiträge zur angeborenen Pylorusstenose. Virchow's Arch. f. Path. Anat., etc., Berl., 1885, cii.
47. Riegel. Nothnagel's Encyclopedia of Diseases of the Stomach, 1903.
48. Poensgen, E. Die motorische Verrichtungen des menschlichen Magens und ihre Störungen. Priesschrift, Strassburg, 1882.
49. Hirschsprung, H. Stenosis pylori congenita. Hospitalstidende, 1901, 47.
50. Ibrahim, J. Die Pylorusstenose der Säuglinge. Ergebn. d. innere Med. u. Kinderh., 1908, i.
51. Pfaundler, M. Beiträge zur Frage der "Pylorusstenosen" in Säuglingealter. Jahrb. f. Kinderh., 1909, 70.
52. Koplik, H. Congenital Pyloric Spasm and Congenital Hypertrophic Stenosis of the Pylorus in Infancy. Am. J. M. Sc., 1908, cxxxvi.
53. Wernstedt, W. Om spastisk pylorus kontraktur hos späde barn och medfödd pylorusfortraengning. Hygiea, 1910, No. 5.
54. Rammstedt. Zur Operation der angeborenen Pylorusstenose. Med. Klin., Berl., 1912, No. 42.
55. Doyen, E. Traitement chirurgical des affections de l'estomac. Paris, 1895.
56. Lerche, W. Remarks on Cardiospasm, with Special Reference to Treatment and the Use of the Œsophagoscope for Examination. Am. J. M. Sc., 1912, March.
57. Hedblom and Cannon. Some Conditions Affecting the Discharge of Food from the Stomach. Am. J. M. Sc., 1909, cxxxviii.
58. Katschowski, P. Das Überleben den Hunde nach einer gleichseitigen doppelten Vagotomie am Halse. Arch. f. d. ges. Physiol., Bonn, 1901, lxxxiv.
59. Ley, H. Über Achylia gastrica und ihre Beziehung zur Motilität, etc. Arch. f. Verdauungskr., 1911, xvii.
60. Schnitzler, J. Über einen Krampftumor des Magens, nebst Bemerkungen zum sog. Spasmus pylori. Wien. med. Wchnschr., 1898, No. 15.
61. Alberti. Deutsche med. Wchnschr., 1901; Vereinsb., No. 2, s. 13.
62. Brunner, C. Zur chirurgischen Behandlung des Spasmus pylori und der Hyperchlorhydrie. Beitr. z. klin. Chir., 1901, xxix.
63. Schloffer, H. Operation by gutartiger Magenkrankungen. Beitr. z. klin. Chir., 1902, xxxii, 310.
64. Dauwe, O. Pylorectomie pour spasme pylorique rebelle, à caractères cliniques cancereux. Ann. Soc. de méd. d'Anvers, 1911, 73.
65. Venot, M. A. Spasm du pylore; pyloroplastie. Gaz. hebd. d. Sc. méd. de Bordeaux, 1911, 32, 461.
66. Manasse, P. Zur Lehre vom Pylorospasmus. Berl. klin. Wchnschr., 1912, No. 6.
67. Cannon and Blake. Gastro-enterostomy and Pyloroplasty. Ann. Surg., Phila., 1905, xli.
68. Kelling, G. Studien zur Chirurgie des Magens. Arch. f. klin. Chir., 1900, lxii.

69. BERG, A. A. Duodenal Fistula: Its Treatment by Gastrojejunostomy and Pyloric Occlusion. Ann. Surg., Phila., 1907, xlv.
70. JIANU, A., and GROSSMAN, J. Die Veranderungen der Magenschleimhaut nach Pylorusausschaltung (Exclusio Pylori). Arch. f. Verdauungskr., 1910, xvi.
71. VON TAPPEINER, H. Zur Frage der Pylorus Ausschaltung. Beitr. z. klin. Chir., 1912, lxxx.
72. WILMS, W. Umschnürung und Verschluss des Pylorus, durch Faszienstreifen. Deutsche med. Wchnschr., 1912, 3.
73. VON EISELSBERG, A. Über Ausschaltung in operabler Pylorusstricturen nebst Bemerkungen über die Jejunostomie. Arch. f. klin. Chir., 1895, l.
74. BEARDSLEY, H. Congenital Hypertrophic Stenosis of the Pylorus. Med. Soc. New Haven County, Conn., 1788. Reprinted in Arch. Pediatr., 1903, 355.
75. COHENHEIM, O. Beobachtungen über Magenverdauung. München. med. Wchnschr., 1907, 52.
76. RIEDER, H. Die Sanduhrformen des menschlichen Magens. Wiesbaden, 1910.
77. MOYNIHAN, B. G. A. Remarks on Hour-Glass Stomach. Brit. M. J., 1904, Feb. 20.
78. BÜDINGER, R. Zur Pathologie und Therapie des Sanduhrmagens (Spastischer Sanduhrmagen, Magenresection, Gastroplastik). Wien. klin. Wchnschr., 1901, 36.
79. SCHMITT. Zur Diagnosis des Sanduhrmagens. Arch. f. klin. Chir., 1906, 81, 487.
80. BARON und BARSONY. Spastischer Sanduhrmagen bei duodenalen Affektionen. Wien. klin. Wchnschr., 1912, 31.
81. HAUDEK, M. The Röntgen Diagnosis of Chronic Gastric Ulcer. Arch. Röntgen-ray, 1911, June.
82. JOLASSE. Beiträge zur Röntgendiagnose des Sanduhrmagens. Fortschr. a. d. Geb. Röntgenstrahl., 1907, xi.
83. VON SCHMIEDEN. Die Differentialdiagnose zwischen Magengeschwur und Magenkrebs, etc. Arch. f. klin. Chir., 1911, 96, 252.
84. STIERLIN, E. Röntgenologische Erfahrungen über Magenspasmen. München. med. Wchnschr., 1912, 15 and 16.
85. DE QUERVAIN, F. Zur Röntgendiagnostic des runden Magengeschwurs. München. med. Wchnschr., 1911, 17.
86. HARTEL. Diagnostische und therapeutische Erfahrungen beim Sanduhrmagen. Arch. f. klin. Chir., 1911, xcvi.
87. PERTHES. Über verschiedene Formen von Sanduhrmagen. München. med. Wchnschr., 1912, No. 39.
88. HERTZ, A. F. Functional Hour-Glass Stomach. Proc. Roy. Soc. Med., Lond., 1912, v.
89. FAULHABER. Zur Röntgendiagnostik des tiefgreifenden (kallösen) Ulcus Ventriculi. München. med. Wchnschr., 1910, 40.
90. CLAIRMONT and HAUDEK. Die Bedeutung der Magenradiologie für die Chirurgie. Jena, 1911.
91. STILLER, B. Kritische Glossen eines Klinikers zur Radiologie des Magens. Arch. f. Verdauungskr., 1910, xvi.
92. KAUFMAN und HOLZKNECHT. Die Peristaltik am Antrum pylori des Menschen. Mitt. a. d. Lab. f. radiol. Diagn. u. Therap. im. k. Allg. Krankenh. in Wien, Jena, 1906, i, Heft 1.
93. SCUDDER, C. L. Congenital Stenosis of the Pylorus. Surg., Gynec. & Obst., 1910, xi, 287.
94. HOLZKNECHT und FUJINAMI. Prüfung des Magens auf "rohre Motilität" mittels der Durchleuchtung. München. med. Wchnschr., 1912, No. 7.
95. SCHÜTZ, E. Über Spasmus pylori. Arch. f. Verdauungsk., 1909, xv.
96. ENGEL. Der "Magensaftfluss" in der Pathogenese und im Verlauf der Pylorusstenose der Säuglinge. Deutsche. med. Wchnsch., 1909, No. 29.
97. HOCHENEGG, J. Ein Fall von Schussverletzung des Oesophagus im Brustteile. Wien. klin. Wchnschr., 1912, No. 1.
98. KÜTTNER, H. Druckdifferenz Operationen. Beitr. z. klin. Chir., 1908, lx, 36.
99. FRITSCH, K. Die doppelseitige gleichseitige intrathorakale Vagotomie unter Druckdifferenz. Beitr. z. klin. Chir., 1910, lxx.
100. FRIEDENTHAL, H. Beiträge zur physiologischen Chirurgik der vom Sympathicus innervirten Organe. Arch. f. Anat. u. Physiol., 1905, 132.
101. EPPINGER, H., und HESS. Zur Pathologie des vegetativen Nervensystems. Ztschr. f. klin. Med., 1909, 67.
102. PETREN, K., und THORLING. Untersuchungen über das Vorkommen von "Vagotonus und Sympathicotonus." Ztschr. f. klin. Med., 1911, 73.
103. BAUER, J. Zur Functionsprüfung des vegetativen Nervensystems. Deutsche Arch. f. klin. Med., 1912, cvii.
104. VON BERGMANN, G. Das spasmogene Ulcus peptic um. München. med. Wchnschr., 1913, No. 4.
105. LICHTENBELT. Die Ursachen des chronischen Magengeschwures. Jena, 1912 (Gustav Fischer).
106. RÖSSLE, R. Das runde Geschwür des Magens und des Zwölffingerdarmes als "Zweite krankheit." Mitt. a. d. Grenzgeb. der Med. u. Chir., 1912, xxv, No. 4.
107. EPPINGER, FALTA, u. RÜDINGER. Über die Wechselwirkung der Drusen mit innerer Sekretion. Ztschr. f. klin. Med., 1908, lxvi.

# DEPARTMENT OF TECHNIQUE

## A SIMPLE APPARATUS FOR TRANSFUSION BY THE ASPIRATION–INJECTION METHOD

By BERNARD FRANCIS McGRATH, M. D., Rochester, Minnesota
Mayo Clinic

In rather recent times, transfusion by the method of aspiration and injection has been revived and quite frequently applied. In its favor are simplicity, sureness, and exact estimation of the amounts of blood transmitted. Different devices for the mode of transfusion have been advocated, but all are modifications of apparatuses used years ago (Howe, Colin, and others). Among others, the writer has found that a glass syringe with needle, or its

Fig. 1. Rubber bulb (about 30 ccm.) and tips for insertion into vessels of donor and recipient. No Joints.

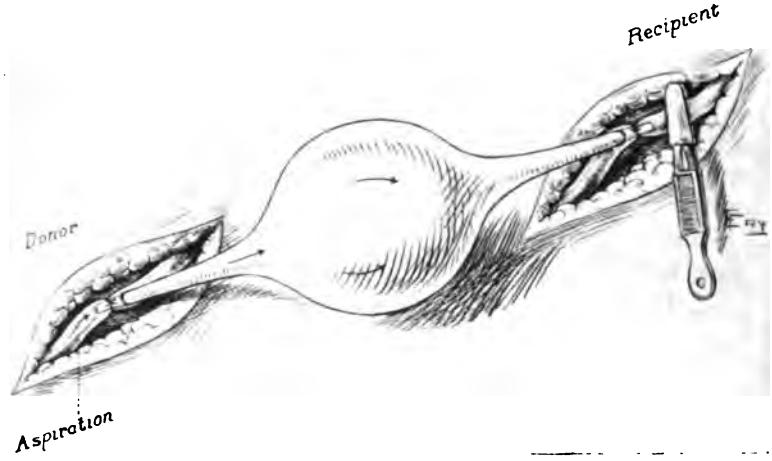



Fig. 2. Apparatus filled with salt solution and tips fixed in vessels by ligatures. Salt solution expressed and serrefine clamp applied to recipient's vessel. Aspiration from donor's vessel until bulb is filled with blood.

Fig. 3. Serrefine clamp changed to donor's vessel and blood injected into recipient.

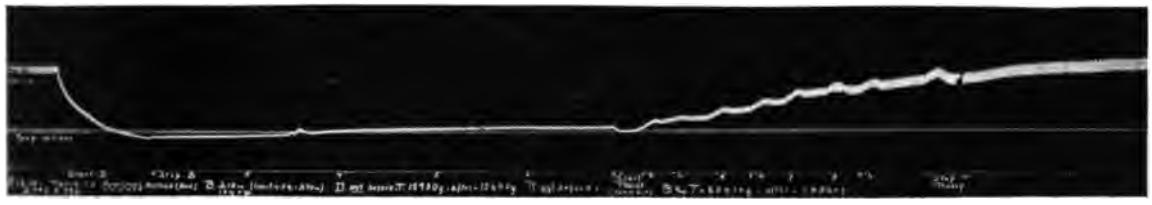


Fig. 4. Experiment bleeding and transfusion. Method, aspiration-injection, with accompanying depicted apparatus. Dogs used for experiment. Tracing of recipient. First half of record shows effect of bleeding 104.3 gms. (weight of recipient 6041 gms.). Second half of record shows effect of transfusion, the blood pressure returning to normal in a series of elevations, each of which corresponds to an injection of blood.

end drawn out to suitable size, is practicable. Anti-coagulants are not essential, and probably are better avoided. The indirect method has opponents, but frequent favorable clinical reports are to be duly considered. The accompanying depicted modification of Aveling's method has proved successful in the writer's experimental work. The procedure is simple and rapid in execution and positive as to results. The amount of blood transfused can be closely estimated as may be seen by the accompanying illustrations (Figs, 1, 2, 3, and 4).

# TECHNIQUE OF CLOSING THE ABDOMINAL INCISION

By HOWARD F. KANE, A. B., M. D., Washington, D. C.
House Surgeon, Columbia Hospital for Women

An article by Dr. J. Wesley Bovée,[1] entitled "The Preferable Technique of Closing the Incision in Abdominal Section and Herniotomy," appeared in 1901. Since that time he has abandoned for his work all suture material except iodine catgut, prepared as described by him,[2] and kangaroo tendon. He has almost entirely abandoned the abdominal bandages after operations, perhaps not using one bandage in a thousand cases, and very rarely employs interrupted sutures.

Of course, since adopting iodine sterilization for the operative field, corrosive sublimate gauze is not used, plain sterile gauze being used in contact with the wound. He has for fully ten years used a true purse-string suture for closing the peritoneum to lessen the danger of intraperitoneal adhesions still more than did the whip stitch previously described by him. When through-and-through sutures were used for closure such peritoneal eversion was studiously avoided, as it was regarded as endangering hernia. With the tier suture it does not create such fear.

A few weeks ago Dr. Bovée learned this plan devised by him was not new, as it had been described and illustrated twenty-six years before[3] by R. Stansbury Sutton, of Pittsburgh. Perhaps it is unnecessary to add that he employs overlapping of fascia in ventral hernia and diastasis recti abdominis. His plan of closing the simple, subumbilical median incision is with five layers of suture, one of which, the main or rectal sheath, is of kangaroo tendon of medium size and the others of No. 2 iodized catgut. The incision is usually made nearly or quite one-fourth of an inch to the right of the median line and after exposing to view the right rectus muscle that structure is separated from the linea alba by blunt dissection and the transversalis fascia divided in turn about one-fourth inch from the linea alba. The peritoneum and subperitoneal fat and fascia are carefully lifted and divided to correspond to the preceding dissection. Almost never are hæmostatic forceps applied to the wound, bleeding yielding to compression with hot, wet gauze.

In closing the incision when it is less than six inches in length, the plan we now recognize as the Sutton method is used. Fig. 1 shows the plan of closing the peritoneum. The peritoneal margin on either side at the middle of the wound is lightly grasped by a small hæmostatic forceps which stabilizes it while the suture is placed. A No. 2 iodized catgut in a curved needle is first passed from without inward through the peritoneum about one-fourth of an inch back of the forceps grasping the edge opposite the operator. It is made to re-enter the peritoneum about one-fourth inch toward the umbilicus. This plan of weaving in and out through the peritoneum about one-fourth of an inch from the margin is continued around to the starting point. An assistant now carefully draws taut and ties this suture while the operator prevents protrusion of viscera.

The transversalis fascia is closed with the same suture (Fig. 2) which has not been severed, and may be placed in the ordinary spiral form. The peritoneum being more firmly attached in the umbilical region than near the lower end of the incision, it is carried by the purse-string suture to the upper end of the wound and therefore the transversalis fascia is sutured from that end toward the pubes. The suture in that structure is finally tied by the well-known crochet stitch, two stitches being taken and the end pulled through the loop and cut off an inch from it. The fascia forming the external sheath of the rectus muscle is now closed with kangaroo tendon of the medium size, using the lock stitch of the sewing machine for the purpose. This is practically the shoemaker's stitch as employed by Marcy (Fig. 3). It may be placed more rapidly than the shoemaker's stitch as it obviates the necessity of unthreading and threading the needle at every stitch. One end of the suture is fastened into the eye of a needle fashioned after the Peaslee perineal type and the other end is picked up by an assistant. Beginning at one end of the incision, the needle is pushed through the fascia on both sides until the threaded eye is well exposed. The assistant now passes the end he holds through the space between the needle and the suture as they lie closely paralleled and again grasps the free end. The needle is now withdrawn and the stitch is locked.

This process is continued at intervals of one-

[1] Am. J. Obst., N. Y., 1901, xliii, 289.
[2] Am. J. Obst., N. Y., 1907, lvi, 366.
[3] A new method of closing the peritoneal sac after Tait's operation. Gynec., Tr., 1887, xii, 57.

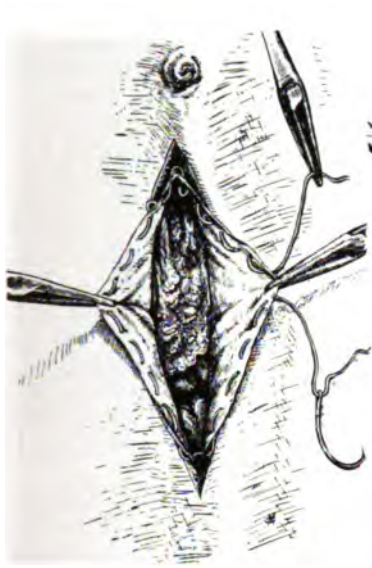


Fig. 1.

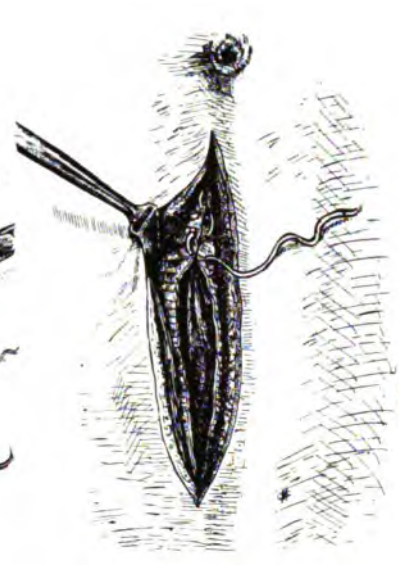


Fig. 2.

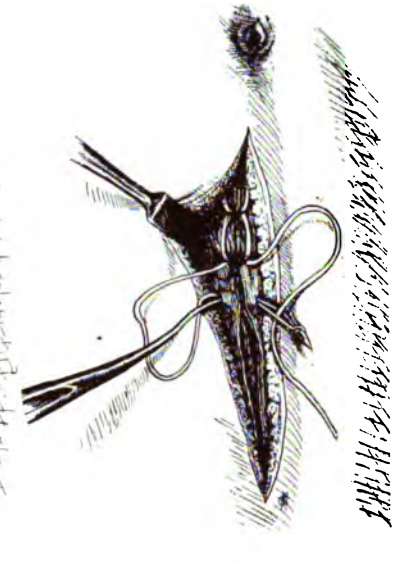


Fig. 3.

Fig. 4.

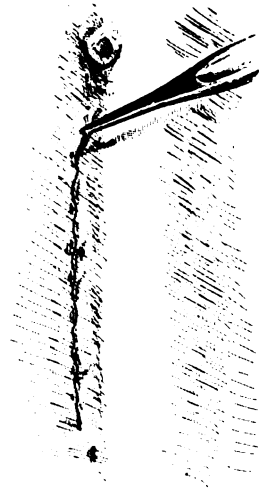


Fig. 5.

Fig. 6.

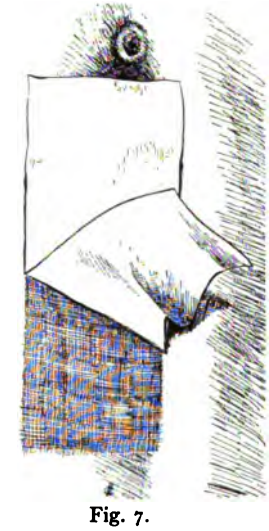


Fig. 7.

fourth to one-half an inch until the other end of the wound is reached and the two ends of the suture tied in a square knot.

The subcuticular fat is now closed by a spiral suture of No. 2 iodized catgut (Fig. 4). The ordinary curved needle with cutting lateral edges is passed through the fascia in the extreme upper end of the wound and instead of tying the suture the free end of it is simply held by a forceps. A spiral suture now closes the fat, care being exercised that the needle lightly picks up the fascia each time it crosses the median line at the depth of the wound. Without securing or severing the suture when it is finished, the same suture material and needle are used to close the skin by a subcuticular suture (Fig. 4) which, when placed, stops at the umbilical end of the wound. The two suture ends, one attached to the fascia and held by forceps, and the other still in the needle, are liberated and tied together and the knot thus formed readily settles to some point between the skin and fascia and is therefore buried. The

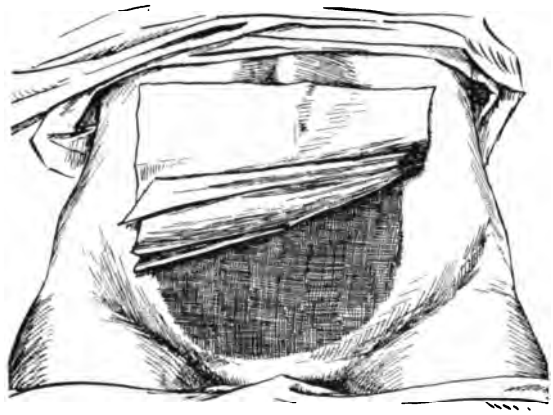


Fig. 8.

cut ends are easily pushed under the skin (Figs. 5 and 6) and we have a wound closed completely and with absorbable suture material completely buried (Fig. 6). When this layer of fat is so thin that it does not need suturing, a different plan is adopted. The subcuticular suture is fastened to the fascia at the upper end of the wound and then inserted. At the lower, or finishing, end it is tied to the catgut closing the transversalis fascia or to the kangaroo tendon closing the fascia.

No effort is made to clean the skin in the field of operation, but a few layers of sterile gauze, two inches wide and two inches longer than the incision, are carefully placed over the sutured wound and in turn covered by a layer of oiled paper (Fig. 7). The abdomen is now covered by a well fitting pad of gauze, six to ten layers, soaked in flexible collodion. Over this a layer of rubber sheeting is placed (Fig. 8) to prevent collodion adhesions between dressings and the clothing of the patient or bedding. An hour or two later, the collodion having dried, this sheeting is removed and the dressing is removed thirteen days after operation — one day before the patient is out of bed. Usually no subsequent dressing of any kind is needed, although a layer of muslin or silk between the scar and corset is advised for a few months.

When the wound is more than six inches in length the peritoneum is closed by a continuous, spiral suturing, the cut edges being turned toward the skin, during the process, sufficiently to prevent their being exposed in the peritoneal cavity.

In very rare instances only are additional interrupted sutures, either single or mattress, used. In all other respects the closure is the same in long as in short incisions. In umbilical or other ventral herniæ, fascia overlapping oftimes is required.

---

## SCALPEL SURGERY OF TUMORS OF THE BLADDER

By G. SHEARMAN PETERKIN, M. D., F. A. C. S., Seattle, Washington

FIFTY-THREE per cent of mortality in total extirpation of the bladder and 45 per cent in suprapubic resection, if the mortality following recurrence is included, are the statistics that confront the profession of medicine in operation by means of the knife on tumors of the urinary bladder. This being true, a vital question arises: How can the science of surgery reduce this appalling mortality?

At present the general surgical world does not recognize that surgically the bladder is often practically located in the peritoneal cavity, and this fact, combined with the anatomical structure and physiological functions of this organ, indicates rather than contra-indicates radical surgical methods.

It is the writer's opinion and experience that the principles of surgery of to-day as applied to malignant growths in other parts of the body—the breast, for example—are applicable to the bladder; and the answer to the question propounded is to be found in the maxim, ever to be borne in mind, "The more radical the operation the greater the percentage of cures."

The term radical as here used signifies opening the peritoneal cavity whenever by so doing it gives freer access to the pathological area, and cutting wide of the tumor to the extent of removing all the layers of the bladder wall, including the peritoneum, at least one inch beyond the area involved.

That this is not radical, and that it is the premises upon which the general principles of surgical technique must be constructed that will govern operations upon tumors of the bladder, the writer will attempt to prove, and in so doing will out-

Fig. 1. After Hagner. Use of sutures to outline bladder tumor.

line the general principles of surgical technique which, if employed, will lessen the percentage of operative mortality and increase the percentage of cures over those now attained through operative treatment of bladder tumors.

The term non-radical is defined as suprapubic resection when opening the peritoneal cavity will give better access to the field of operation—the cutting out of some layers instead of wide excision of all layers of the bladder wall surrounding the tumor, operating through an operating cystoscope, a method as antiquated as Bottini's operation on the prostate.

Fig. 3.

EVIDENCE THAT OPENING OF BLADDER VIA PERITONEAL CAVITY IS NOT DANGEROUS

(*a*) Laboratory experimentations upon animals by Barney, Tuffier, de Quervain, and others, have demonstrated that normal urine is not very irritating to the peritoneum, and the chances of infection are small.

(*b*) Reported clinical cases of rupture of the bladder with recovery after urine has escaped into peritoneal cavity (Alexander, Zuckerkandl, Keyes, and others).

(*c*) The transperitoneal method of operations on bladder growths as suggested by Rydygier in 1888, advocated by Harrington in 1893, and popularized by the Mayos in 1908, which method gives 9 per cent mortality as against 20 per cent by suprapubic resection (Watson).

(*d*) Demonstrations by Tennant, of Colorado, that transperitoneal cystostomy can be done even in presence of severe cystitis without danger.

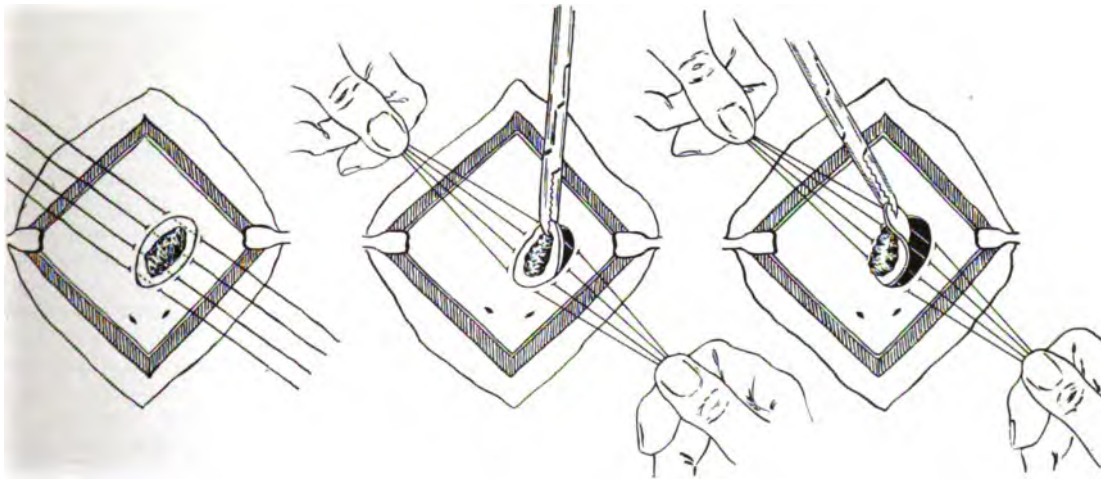


Fig. 2.

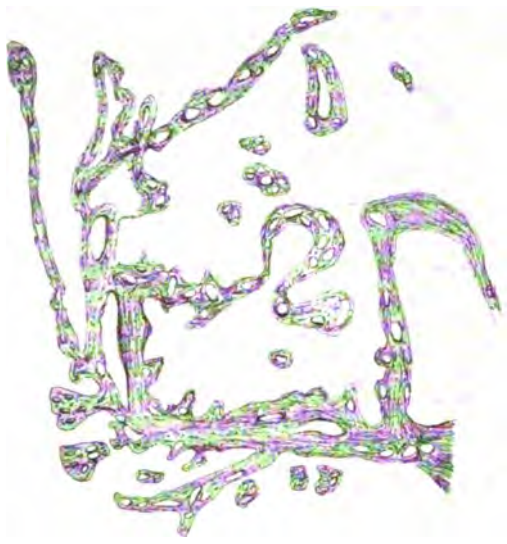


Fig. 4. Papilloma of bladder. Showing the complex character of the villi and very liberal blood supply.

Fig. 5. Papilloma of urinary bladder. Showing infiltration in carcinomatous degeneration: a, epithelium stratified columnar in type; b, small round cells, numerous in the papillæ; c, epithelial cells invading stroma of round cells; d, blood-vessels.

(*e*) An experience encountered by virtually every surgeon who has operated extensively—the accidental opening of the urinary bladder during operations, with no bad results.

Evidence that the anatomical structure and physiological functions of the bladder are such that free excision of its walls is not contra-indicated is furnished by cases reported by Harris of Chicago, Zuckerkandl, Rövsing, and others; also three cases by Kolischer and Schmidt, where more than two-thirds of the bladder wall was removed, the healed bladder having a capacity of 250 to 300 ccm. within eight weeks.

Unquestionably such evidence demonstrates that the anatomical locality, structure, and physiological functions of the bladder do not contra-indicate radical methods. Yet the question remains to be answered, why a cutting operation should virtually always be radical. The answer is self-evident.

1. No cystoscopist can tell by means of cystoscopy whether a tumor is benign or malignant.

2. No pathologist can tell whether any bladder tumor is benign or malignant unless he examines the whole tumor; to permit him to do this would necessitate a radical operation.

3. Hugh Cabot, E. Hurry Fenwick, Sir Henry Thompson, Watson, Kolischer, Israel, Cathelin, and most of the well-known urologists agree that clinically about one-half of all bladder tumors are malignant.

4. The same urologists believe that in the most frequent of all so-called benign tumors, the papilloma, there is a recurrence of almost 40 per cent after operation (Fenwick).

To reiterate, these facts exist: About one-half of the bladder tumors are malignant; 40 per cent of benign tumors recur after operation; the cystoscopist and pathologist have no means of making a preoperative diagnosis as to malignancy of tumors. Therefore, we are more logical and less radical in considering all tumors of the bladder malignant until our present methods of diagnosis are improved.

Moreover, that we can consider them malignant with less danger to the patient is demonstrated:

(1) By clinical experiments showing that in operations on the bladder, even if only a small portion of the bladder wall is left, this remaining portion has the power of development to the extent of almost regaining the total physiological bladder capacity; and (2) by the low mortality of the transperitoneal operation as against suprapubic resection.

With such a collection of facts, can the surgical world give any logical reasons why operations on the bladder should not be radical, as here defined?

In concluding this part of the argument, to show the value of radical versus the non-radical operations in obtaining a cure, let me again quote Watson, who in February, 1913, presented

Fig. 6. Ureter openings before the apparatus is applied.
Fig. 7. Ureter openings after the apparatus is applied. Note the pouching of the ureter, especially the right projecting so that it has the appearance of an erect nipple; protruding thus causes the urine to drop in the cup, not to seep along the skin.

Fig. 8. Inside of apparatus. Entire apparatus composed of rubber.
Fig. 9. Exterior of apparatus.

statistics of 62 cases of real radical operations (total extirpation) with 33 deaths, 14 post-operative deaths, and 16 recoveries (and in all cases of death only two were attributed to recurrence), as against 103 cases of suprapubic resection, with 20 per cent deaths, 50 per cent recurrence, to be followed by 62 per cent mortality.

Comparing total extirpation with suprapubic resection, the latter presents a far greater percentage of recurrence, since if we review the histories of the non-radical operations we find most of them are virtually operations of election, not of necessity, as were the operations of total extirpation.

Being radical alone will not reduce the mortality, and such is not the claim of the writer for an instant. The essential subsidiary aids of correct surgical technique are equally as important. By accepting as a premise upon which to work the radical operation as here defined, then logically reviewing the causes of operative deaths, the means of preventing such deaths will become evident and can be classified so as to be of actual working value.

To demonstrate: Exclusive of faulty technique due to lack of asepsis, to lack of anatomical knowledge and to inexperience, the causes of death after operations on tumors of the urinary bladder are: (1) Shock; (2) ascending renal infection; (3) uræmia; (4) recurrence and metastasis.

The first cause of death, shock, is preventable through (1) early diagnosis; (2) shortening the duration of operation; (3) preventing hæmorrhage; and (4) proper preoperative preparation—the selection of cases, anæsthetist, and anæsthetic.

1. *Early diagnosis.* The clinical sign that permits of early diagnosis is hæmaturia, especially symptomless. Though this hæmaturia has the clinical characteristics of appearing without cause, being unaffected by rest, position, or exercise, nevertheless cystoscopy by an expert cystoscopist is imperative, for by no other means can the source of the hæmorrhage be located and the size, number, position, and possible characteristics of the tumor be ascertained.

2. *Shortening duration of operation.* This is attained (*a*) by formulating a definite plan of procedure previous to operation, through cystoscopically locating the exact position of tumor or tumors, outlining the amount of bladder wall to be removed, etc., and then perfecting a technique that will permit of readily marking out the area to be removed, whether the bladder is collapsed or not (Fig. 1, after F. R. Hagner).

(*b*) By increasing the size and clearness of the visual field by a long abdominal incision, by opening the peritoneum, by position of the patient, etc.

(*c*) By keeping field of operation dry when bladder is opened through catheterization of both ureters previous to operation, administering ether, or preferably chloroform, and placing the patient in the Trendelenburg position, as under these conditions anuria is produced and practically very little urine enters the bladder (Bovée).

(*d*) By catheterizing the ureter near which the tumor is located previous to operation, thereby clearly defining its outline and locality, so as to

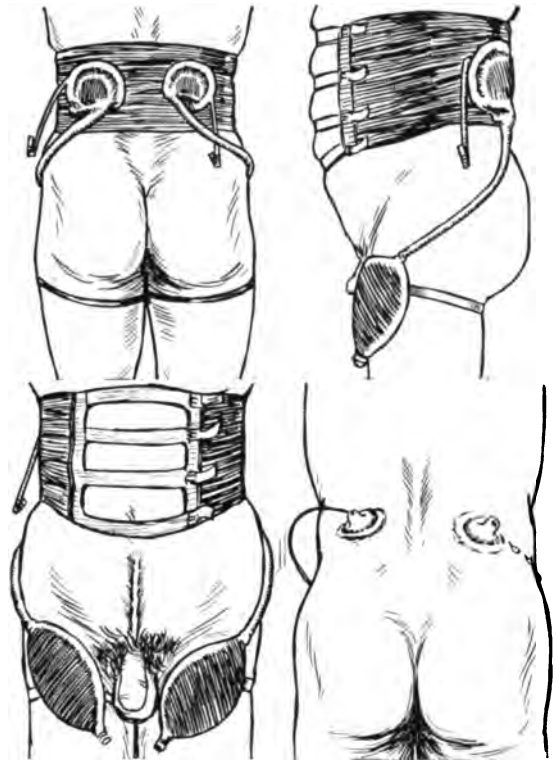


Fig. 10. Apparatus applied. Four and one-half inches from center, two inches from crest.

permit removing of bladder area near ureter without injury of same and the more ready transplantation of this canal if necessary.

(*e*) By permitting escape of contents of bladder through urethral catheter or cystoscope after marking out area to be removed, to prevent metastasis, wasted time in sponging, and postoperative shock through possible sepsis from contents of the bladder.

3. *Preventing hæmorrhage.* This is done by employing technique that will eliminate the direct handling of the tumor, as follows: Insert No. 2 catgut suture just beyond edge of healthy bladder wall to be excised, then under tumor (the finger in rectum or vagina if tumor is at base) to a similar point in bladder wall on opposite side. Now incise bladder wall (all layers) and grasp same with forceps as illustrated (Fig. 2); then, an assistant using these sutures and the surgeon the forceps as tractor, excise tumor.

4. *Proper preoperative preparation.* Time prohibits the consideration of these factors that would aid in preventing shock, yet the author personally recommends the use of spinal anæsthesia in bladder tumors whenever possible, and would refer the readers interested in this form of anæsthesia to the articles in the bibliography on this subject.

The second cause of death, ascending renal infection, is prevented (1) by transplanting the ureter in one of two places—the bladder or the lumbar region, for in both instances, should infection take place, it can be cured by local treatment, which cannot be done if the ureters are transplanted in any parts of the intestines or concealed part of the body; (2) by selecting the points of exit and maintaining direction of transplanted ureters so as to prevent back pressure (note Case 3).

The consideration of the third cause of death, uræmia, is omitted in this paper, as its pathological phenomena are within the province of the internist and cannot be prevented by surgical technique, as can shock, renal infection, and metastasis.

The fourth cause of death, recurrence and metastasis, are prevented (*a*) by early diagnosis; (*b*) by radical operation, as here advocated; (*c*) by no direct handling of tumor so as to break or destroy its continuity, especially a papilloma; (*d*) by walling off with abdominal pads the surrounding abdominal walls and tissues.

As a practical illustration of the value of radical operations on tumors of the bladder, I shall report three cases.

CASE 1. Papilloma. Male patient, married, aged 46. Operated upon December 7, 1909; left hospital fully recovered, December 22; no evidence of recurrence; died June 9, 1913, three and a half years later, with no evidence of bladder involvement, but from chronic morphinism.

*Symptoms.* Profuse hæmaturia and retention due to villi blocking the mouth of bladder, prostate being normal. Growth was located one-half inch to right and one-fourth inch posterior to left ureteric orifice. Photograph of gross specimen (Fig. 3) shows tumor to be of characteristic villus type. Drawings from microscopic sections show: (Fig. 4) By the complex character of villi and their very liberal blood supply that the tumor is benign; (Fig. 5) By the infiltration and carcinomatous degeneration that the tumor is malignant, not benign.

*Points of Interest*

1. Only a small microscopic area showed the true character of tumor, that it was a commencing carcinoma, confirming the statements made as to the cystoscopist's and pathologist's ability to diagnose the benign or malignant character of bladder tumors.

2. All layers of the bladder wall were excised, and at a distance of three-fourths of an inch from the tumor, which probably accounts for its nonrecurrence.

3. The ureter was catheterized to facilitate

its removal and lessen the duration of the operation.

4. The tumor being situated at the base of the bladder, the value is shown of two fingers of an assistant inserted in the rectum to elevate the tumor so as to bring it into better view and shorten the operation. A proctoscope is sometimes more efficient.

5. The cut edges of the bladder wall were united only by interrupted catgut sutures, ten days chromicized. A suprapubic drain was inserted. Experience to-day would, in order to hasten recovery, cause the operator to close the bladder, catheterize every four hours if necessary, and not drain by permanent catheterization per urethra.

6. Never, if possible to avoid it, incise bladder, then excise tumor; by marking out the area to be removed previous to operation, make the only incision into the bladder the excised area, thereby materially aiding in preserving the bladder function, lessening the length of the operation, and hastening recovery.

7. A special point to be remembered, because of the rapidity and frequency with which papilloma recurs, is that cystoscopy should be performed every month for one year, every three months the second year, and every six months the third, in order to anticipate an early recurrence.

CASE 2. Male, age 42, referred by Dr. W. A. Shannon. Sarcoma; operated on May 17, 1910; June 12th patient left hospital; died May 19, 1911; cause, metastasis present in the form of two large sarcomatous masses on spine. Symptoms previous to operation, constant hæmaturia and painful urination when hæmorrhage was severe.

### *Points of Interest*

Over one-half of the bladder wall was removed July 20, 1910; 63 days from the date of operation the bladder capacity was 310 ccm.; no recurrence of bladder symptoms at time of death, showing the power of a small portion of bladder wall to regain virtually the normal physiological capacity of the whole bladder when a large amount of bladder wall is removed.

As the tumor was situated on the right side of the bladder and involved the lateral superior and anterior surfaces, cutting wide of the tumor necessitated excising the bladder wall along the edge of the prostate for a distance of about one inch. Naturally the bladder wall could not be coapted at this point, so a triangular opening in the bladder remained, the base of the triangle being the prostate and the apex the united bladder wall. An incision through the abdominal wall over this opening was then made to the right of the original median abdominal incision, which was closed; a drainage tube was inserted in the second incision, and the wound treated as in suprapubic prostatectomy.

CASE 3. Male, married, age 41; referred by Dr. B. H. Foreman of Tacoma. Diagnosis, carcinoma of bladder. Symptoms: hæmaturia, tenesmus, and pain when bladder was overdistended by blood clots.

*Treatment.* Oudin current from December, 1910, to March, 1911; no improvement. March 19, 1912, chloroform anæsthesia; suprapubic incision; diagnosis, tumor inoperable except by total extirpation. March 25th, the patient consenting, the ureters were transplanted into lumbar region. April 3d, bladder extirpated.

*Results.* Recovery; weight at time of operation, 140 pounds; now 210 pounds; general health excellent.

### PRACTICAL POINTS TAUGHT THE OPERATOR

1. The advantages of operating in two stages, ureterostomy first. The shortest period of time advisable between operations is two weeks, though the resisting power of the patient to operative shock will govern this factor.

2. The character of urinal should be determined before operation, measurements for same made, and point of exit of ureters determined, so that no muscular movement will render the ureteral cups inefficient.

3. The points of exit selected should be marked with nitrate of silver before sterilizing the field of operation.

4. Approximately the best area for ureter openings is three inches from spine of vertebræ and one inch above top of crest of ilium.

5. *Urinal.* Measurement of ureteral cups: outer diameter, 4½ inches, inner, 2 inches; circumference: outer, 13 inches, inner 6 inches. Theory of action: Inflation of the pneumatic tube causes a vacuum, which holds the cups so close to the skin as to prevent leakage of urine or any escape of odor of same, yet does not interfere with motion, as is demonstrated by the patient following his vocation of attendant in the acute mania ward at state insane asylum.

6. Technique of transplanting the ureters: Iliolumbar incision; to save time, strip the peritoneum to the pelvis of kidney, using the pelvis as a guide to the ureter; free the ureter from its bed as low down as possible. Puncture the muscles in a slanting direction, after the method advocated by Watson. Pull the ureter through, then with a finger in the incision ascertain the direction of the ureter; see that there is no kink or sharp curve that will produce back pressure. Confirm the position of the ureter by a flexible ureteral catheter. The ureters in this instance were stitched to the skin, but the operator would not advocate this method, later

experience causing him to prefer the method advocated by Rövsing—that of allowing the ureter to remain free, projecting beyond the external wound, the atrophied portion to be cut off after the ureter has become fixed.

7. An early diagnosis permitted the sexual function to be preserved, by leaving one and one-half inch of bladder wall on the right side. The right seminal vessel was dissected from the bladder; the prostate was left and covered with healthy bladder wall; the sexual functions of the patient are now normal.

8. The pelvis was well packed with strips of packing gauze to the extent of filling the space left by the bladder, so as to prevent intra-abdominal pressure from separating the edges of the excised peritoneum; moreover, permitting the area to granulate up the obliterated cavity caused by the extirpation of the bladder, thus preventing enteroptosis and its sequelæ.

There are many other points, some theoretical and others of practical interest, to be learned from the study of this case, but their value becomes evident only when presented in detail. They are, for instance:

1. The reason for selecting the opening for the ureters at points three inches from the spine and one inch above the crest.

2. The method of keeping the urinal clean, how it should be applied, the cost, etc., as viewed by patient and physician.

3. The explanation of the psychological fact that the patient always feels the sensation of urination when he empties his urinal. Is it due to the fact that the position of the urinal permits him to empty same by simply unbuttoning his trousers as he did before the operation?

4. The fact that one kidney (the right) secretes phosphates continuously so as to incrust the urinal; the left does not.

5. The left kidney (infected) was cleared by treating the pelvis as one would the bladder in cystitis—by irrigation with boracic acid and instillation of argyrol.

6. The report on the functional activity of the kidneys, which have been frequently tested.

7. The X-ray plates of the ureters, pelvis of kidney, and also the urethra.

## BIBLIOGRAPHY


HAGNER, F. R. Report of a Case of Extirpation of the Bladder for Malignant Disease. Med. Rec., 1912, Oct. 19.

IBID. Removal of Carcinoma of the Fundus of the Urinary Bladder. Ann. Surg., Phila., 1910, Nov., 654.

RÖVSING, TH. Total Extirpation of the Bladder, with Bilateral Ureterostomy. Arch. f. klin. Chir., lxxxii, No. 4.

IBID. Extensive Resection of the Bladder. Am. J. Urol., 1912, Jan.

IBID. The Extensive Removal of the Bladder Wall. Mem. Int. Ass. Urol., 1911.

WATSON, FRANCIS S. The Surgical Treatment of Vesical Papilloma and Carcinoma. Urol. & Cutan. Rev., 1913, Feb.

VON RIHMER, BELA. Total Extirpation of the Bladder. XVI. Med-Cong., Budapest, 1909.

PETROW, N. N. Removal of Bladder for Carcinoma. Deutsche Ztschr. f. Chir., 1910, civ, 365.

HARRIS, M. L. Removal of the Bladder and Prostate for Carcinoma through a Suprapubic Opening. Ann. Surg., Phila., 1902, Oct.

MACGOWAN, G. Resection of the Bladder for Malignant Disease. Report of Four Cases. Northwest Med., 1909, Nov.

KOHLMANN, W. Total Extirpation of the Urinary Bladder. South. Med. J., 1908, Sept.

BOVÉE, J. W. Total Extirpation of the Urinary Bladder. Am. Med., 1901, July 1, 58.

PRIMROSE, A. Transperitoneal Resection of the Bladder. Ann. Surg., Phila., 1910, Dec.

MAYO, C. H. Exclusion of the Bladder; an Operation of Necessity and Expediency. J. Am. M. Ass., 1913, June 28.

FERRON, J., and NADAL, P. Tumor of the Bladder. Ann. d. Mal. d. Org. Gen.-Urin., 1910, No. 9.

O'NEIL, R. F. Observations on Recent Cases of Bladder Tumors at the Massachusetts General Hospital, with Special Reference to Operative Technique. Boston M. & S. J., 1913, 305.

RIESE, H. Cancer of the Bladder. Deutsche med. Wchnschr., 1911, Sept. 28.

PILCHER, P. M. Intraperitoneal Operation for Extensive Carcinoma of the Bladder; with a New Method of Treating Divided Ureter. Ann. Surg., Phila., 1911, Nov.

TENNANT, C. E. Intraperitoneal Cystotomy. Ann. Surg., Phila, 1910, Nov.

JUDD, E. S. Tumors of the Urinary Bladder. A Study of 114 Cases. J. Ark. M. Soc., 1912, Aug.

CAULK, JOHN R. Bladder Tumors. Interst. M. J., 1911, Nov.

BABCOCK, W. W. Spinal Anæsthesia; with Report of Surgical Clinics. Surg., Gynec. & Obst., 1912, xv, 606.

KROTOSZYNER, M. Choice of Anæsthesia for Operations on the Genito-Urinary Tract. Am. J. Urol., 1908, Jan.

BARKER, A. E. Experiences with Spinal Analgesia, with Reference to 2354 Cases. Brit. M. J., 1912, 597.

GRAY, H. T. and PARSONS, L. Blood-Pressure Variations Associated with Lumbar Puncture and the Induction of Spinal Anæsthesia. Quart. J. Med., 1912, April.

BAINBRIDGE, W. S. Spinal Analgesia; Development and Status of the Present Method. J. Am. M. Ass., 1912, 1855.

A Few Remarks Concerning 47 Operations for Tumors of the Urinary Bladder. Reports of Hartmann's Clinics, 1912, 4th Ser., 207.

# ON THE BLOCKING OF INFRA-ORBITAL AND MENTAL NERVES AT THEIR FORAMINA TO INDUCE OPERATIVE ANÆSTHESIA IN THEIR CUTANEOUS DISTRIBUTION

By P. G. SKILLERN, Jr., M. D., Philadelphia
Instructor in Anatomy and Surgery, University of Pennsylvania

With the advent of nerve-blocking appear papers that deal with the subject in general,[1] but few that detail the applied anatomical technique. I recently proposed[2] infiltration of the lingual nerve, both for temporary anæsthesia in operations in the anterior two-thirds of the tongue and for permanent relief of chronic pain, as in inoperable carcinoma. Also I proposed infiltration of the auriculotemporal nerve for operations upon the pinna and external auditory canal.[3] The following cases illustrate the title of this paper.

### BLOCKING OF INFRA-ORBITAL NERVE

Case 1. C. F., male, white, aged 53, reported in the Surgical Out-Patient Department of the University Hospital, in the service of Dr. B. A. Thomas, August 15, 1913, presenting upon the lower half of the right side of the nose, just above the ala, an indolent epithelioma (rodent ulcer) of two years' duration. It was the size of a thumbnail, shallow, and covered with dried blood crusts, removal of which provoked no bleeding. It was decided to desiccate the ulcer with the high-frequency spark, and the problem of anæsthesia presented itself. On account of the denseness of the tissues in this situation, and on account of the lateral cartilage of the nose forming the floor of the ulcer, infiltration was not feasible. Being in the territory presided over by the nasal branch of the infra-orbital nerve, it occurred to the writer to block that nerve at its emergence from the infra-orbital canal. Accordingly, 2 ccm. of a 2 per cent solution of novocaine with adrenalin 1:3000 was prepared and drawn into a syringe, the needle of which sought the infra-orbital foramen 1 cm. below the lower margin of the orbit and midway between the canthi. The foramen was found without difficulty, paræsthesia obtained, and the nerve blocked. The external nasal branch of the ophthalmic nerve was then infiltrated at its emergence between the nasal bone and the lateral nasal cartilage. A thorough desiccation was applied without any pain.

Since the infra-orbital nerve supplies the upper teeth, it seems possible to infiltrate it in its canal for the relief of toothache and for the painless extraction of teeth. Accordingly, I injected this nerve with methylene blue in a cadaver, exposed the canal by removing the orbital contents, and found that the solution had stained the nerve as far back as the sphenomaxillary fossa. I have had no opportunity of trying this method out in practice, but mention it in the hope that it may prove useful.

[1] Harris. J. Am. M. Ass., 1913, lxi, 1040.
[2] Surg., Gynec. & Obst., 1913, xvii, 114.
[3] Boston M. & S. J., 1913, Oct. 2.

### BLOCKING OF THE MENTAL NERVE

Case 2. M. S., male, white, aged 52, insurance collector, was brought to me by Dr. C. M. Ewing of Philadelphia, presenting a superficial ulcer 1.8 cm. in diameter (the size of a dime) in the center of the lower lip, with its anterior border at the mucocutaneous junction. Duration, four years. Surface of ulcer dry and it did not bleed readily. Extended in depth to, but did not involve, the orbicularis oris. Submental lymph-nodes not palpable. Submaxillary enlarged on both sides to size of pea, but this was readily accounted for by the carious and tartared teeth, with their marginal gingivitis. It was planned to excise a piece for histological examination and, since the ulcer was so superficial and indolent, to desiccate the remainder with the high-frequency spark. The patient was nervous and desirous of avoiding pain, and requested that no needle be inserted near the ulcer. Accordingly, it was decided to block the mental nerve, and as the ulcer occupied the center of the border of the lip, it was patent that both sides must be anæsthetized.

A spot on the skin which lay before the mental foramen was iodinized and infiltrated intradermically with a drop of a solution of 2 per cent novocaine with adrenalin 1:3000. The hypodermic needle was withdrawn and a minute later reinserted perpendicular to the surface of the mandible to seek the mental foramen. The position of this foramen may best be understood by stating that in skiagrams of the mandible it can readily be mistaken for a focus of disease just below the roots of the second premolar tooth. More specifically, it interrupts the external oblique ridge at about midway between the alveolar and inferior borders of the mandible. Its direction is downward, forward, and inward. If the alveolus has been absorbed, due allowance must be made, for now the foramen lies close to the upper border of the mandible (basilar part). Its diameter is one sixteenth of an inch (1.5 mm.). A finger of one hand was placed in the buccal cavity and followed the second premolar until halted by the reflection of the mucous membrane. This was to insure against the needle entering the buccal cavity as an atrium of infection. Entrance of the needle into the foramen was signalized by its sudden drop and by paræsthesia of the nerve. One ccm. of the same solution was injected. The opposite side was similarly treated. Perfect anæsthesia in the distribution of both nerves was almost immediately obtained. A piece of ulcer was excised and the remainder desiccated with a long, deeply penetrating high-frequency spark without any pain whatsoever. A minute branch of the inferior coronary artery was cut, but the oozing was readily checked by pressure with cotton saturated with a strong solution of permanganate of potash mixed with adrenalin.

So perfect was the anæsthesia that I could readily have removed the ulcer radically and performed cheiloplasty, particularly since there was no patent metastatic carcinoma of the submental

lymph-nodes to take me beyond the anæsthetized area. For the removal of these cervical lymph-nodes it is feasible to block the second cervical nerve at the middle of the posterior border of the sternomastoid muscle.

The dental branches to the incisor and canine teeth may be blocked through the mental foramen, and since both nerves supply six teeth, genuine painless dentistry would be realized for nearly one-fifth of all the teeth, and at least for the most sensitive ones. Toothache in any of the six may be readily relieved.

---

# MANAGEMENT OF LABOR IN CASES WITH RELATIVELY CONTRACTED PELVES

By NEVIL M. GARRETT, M. D., Frankfort, Kentucky

A SUSPICION of pelvic deformity is aroused by smallness of a woman's stature, by a waddling gait, and by malformation of her limbs or spine; also, in the case of a primipara, by a pendulous abdomen and by the fœtal head not being fixed at the brim at the commencement of labor, and in a multipara, by a history of previous tedious and instrumental labors."

The presence of one or more of the above symptoms should not be taken as positive evidence that the pelvis is contracted, but when seen before the onset of labor, they do call for an investigation of the case, that an idea of the size of the pelvis may be formed.

I believe it to be good practice to make a digital examination of all obstetrical patients, at least a month before the expected confinement, even though the patient be a multipara who has borne several children without particular trouble. Such a patient may now have an abnormal growth in her pelvis, which will render delivery at term difficult or impossible. Such a growth may have been present at the time of the last delivery, and have been of such small size as to have caused no particular trouble, but since that time may have attained such size that we will be compelled to reckon with it.

In all primipara, and those multipara whose last labors have been particularly difficult, we should form an idea as to the size of the pelvis by the use of the pelvimeter.

The diameters of the most practical importance are the internal conjugate, external conjugate, interspinal, intercristal, transverse of outlet, and anteroposterior of outlet. A marked diminution in the interspinal and intercristal diameters leads to the suspicion of a transversely contracted pelvis. If the intercristal diameter is no greater than the interspinal, or if it is less, the pelvis is probably rachitic. A notable diminution in the external conjugate shows that we have to deal with a flattened pelvis. If the three principal external measurements are unusually short, but are in the normal proportion to each other, they indicate a generally contracted pelvis, which is the most common variety in the United States.

Inasmuch as the size of the pelvis constitutes only one factor in labor, a woman may give birth to one or more children at term without difficulty, and with another be the subject of a contracted pelvis, owing to the size of the child's head. We can form some idea as to the capacity of the pelvis but we have no accurate way of determining the size of the fœtal head.

The normal internal conjugate diameter, or conjugata vera, is four and three-eighths inches, and is the shortest distance between the anterior surface of the sacral promontory and the posterior surface of the symphysis. It is the available anteroposterior space at the inlet for the passage of the fœtus.

Unfortunately, we have no satisfactory method of measuring this diameter and usually rely on the measurements of the external conjugate or the diagonal conjugate, which is taken by measuring the distance from the sacral promontory to the lower margin of the symphysis and subtracting from five-eighths to three-fourths inches, according to the height and inclination of the symphysis. Any material shortening of the true conjugate constitutes a pelvic contraction.

In studying the treatment of this condition it is well to divide the contraction into the following degrees: That of major contraction, where the conjugata vera is below three inches; medium

contraction, where it is from three to three and three-fourths inches, and minor contraction, where it is from three and three-fourths inches to normal.

Statistics show that about 75 per cent of women with contracted pelves, where the contraction is not absolute, will have spontaneous deliveries, or at least be delivered without major surgical procedures. "Naturally, up to a certain point, spontaneous delivery gives the best results for mother and child. From that point, however, the prognosis becomes less favorable." Cases have been recorded of spontaneous birth through pelves whose internal conjugate diameters ranged as low as two and three-fourths or three inches, but such cases are rare. In flat pelves of three and one-half inches, and generally contracted ones of three and three-fourths inches, there is great probability of spontaneous delivery, but below these figures the chances become less as the size of the conjugate decreases.

In the major and minor degrees of contraction there is not so much room for discussion as to treatment, as the latter, if given sufficient time, will nearly all deliver themselves, some possibly requiring version or the use of forceps. Major cases at term, with viable children, practically all require cæsarean section. The cases allowing the greatest difference of opinion as to treatment are the moderately contracted ones, ranging from three to three and three-fourths inches.

The treatment of such cases varies with different individuals. The doctor who has had several cases, all of which have had spontaneous normal deliveries, naturally does not look upon a relatively contracted pelvis with the same degree of concern as does one who has lost a patient from rupture of the uterus in the same condition.

The principal methods of treatment are:

1. Premature labor at about the thirty-sixth week.

2. Test of labor at term, followed, if necessary, by forceps or version, and in the event of failure to deliver by forceps, this is followed by pubiotomy or cæsarean section.

In the event that version is unsuccessful, craniotomy will most likely be indicated, as the child usually dies unless delivery is rapidly completed when this method is employed.

3. Cæsarean section.

The author has sent the following questions to a number of obstetricians and surgeons:

Number of cases observed?

Where you have charge of the case primarily, what method of treatment do you prefer?

Do you consider the high forceps operation justifiable?

In cases that have been allowed to go to term and cannot be otherwise delivered, do you prefer cæsarean section or pubiotomy?

Which operation has the greater mortality?

What has been your experience as regards union of the bone after pubiotomy?

Fifteen of those addressed replied, but seven failed to supply suitable statistics. However, the remaining eight reported enough cases, including the small number observed by the writer, to make a series of 2,935 cases. The number of cases reported in most instances is approximate, as most of those replying were unable to give the exact number. I feel sure that many cases of absolute contraction were also included.

In reply to the question, "Where you have charge of the case primarily, what method of treatment do you prefer?" three prefer test of labor at or just before term; three prefer induction of labor at about the thirty-sixth week, while one prefers cæsarean section, unless spontaneous labor or low forceps is probable.

Practically all agree to the high forceps operation, under varying conditions, in expert hands. One says that it is never justifiable in first labors and one prefers version.

In reply to the question, "In cases that have been allowed to go to term and cannot be otherwise delivered, do you prefer cæsarean section or pubiotomy?" four, representing 305 cases, prefer cæsarean section, while four others, representing 2,625 cases, prefer pubiotomy, under certain circumstances.

Replying to question 5, five say that cæsarean section has the greater mortality, while two say that pubiotomy has.

Replying to the question, "What has been your experience as regards union of the bone after pubiotomy?" practically all of those who have had experience with the operation, are satisfied with this phase of it. One who opposes pubiotomy says that union is occasionally faulty. It appears that bony union is not essential. In fact, the majority have fibrous union, which may be an advantage in the event that the patient again becomes pregnant.

Just here I think it well to quote exactly the answers of some of those reporting the largest number of cases.

J. Whitridge Williams, who reports upwards of 2,000 cases, says:

"As over 75 per cent of all cases end spontaneously, my conduct in the relatively contracted pelvis is extremely conservative. If the conju-

gata vera is above 7.5 cm., I wait for a spontaneous outcome in primiparous women, unless the child is unduly large; while in multiparæ, I interfere primarily only when the history of past pregnancies indicates the probability of serious dystocia, or when the head is so large as to make it improbable that engagement would occur.

"If spontaneous labor does not occur after a reasonable test of the second stage, I believe that in such cases pubiotomy should be done, provided the mother and child are both in good condition at the time the operation is considered. Under these circumstances, I and my assistants have done between 50 and 60 consecutive pubiotomies without a death. My reason for preferring pubiotomy late in labor to cæsarean section, in the type of cases under consideration, is that the former has a mortality of only 1 or 2 per cent, whereas the latter has one of from 8 to 10 per cent. In my experience ideal results are obtained from the classical cæsarean section only when performed at an appointed time at the end of pregnancy or in the very first hours of labor; its mortality appearing to increase with every hour labor continues.

"In the great majority of my pubiotomies there has been fibrous instead of bony union. This I regard rather as an advantage, as in not a few cases it leads to permanent enlargement of the pelvis and obviates the necessity for interference in future pregnancies. All of my patients have been seen since operation and both they and I are pleased with its ultimate result.

"Do not misunderstand my advocacy of pubiotomy. I regard it as a makeshift operation to be undertaken in cases in which we have overestimated the powers of Nature or underestimated the size and consistency of the fœtal head. It is an operation to be undertaken only after a test of labor. If we feel sure in advance that interference will be necessary, cæsarean section done early is the proper treatment."

A. J. Rongy, reporting approximately 300 cases, in answering question 4, says:

"Depends whether or not the case is supposedly infected. This is determined, as far as possible, by the study of each individual case. The deciding factors usually are: The amount and character of manipulation the patient had, the competency of the physician or midwife, length of time in labor, general condition of patient, such as degree of exhaustion, the character of pulse and temperature.

"If the condition of the mother is such that abdominal section, and with it, the entrance into the peritoneal cavity, is considered an additional danger to the mother, cæsarean section is eliminated and pubiotomy then becomes the operation of choice."

J. Clifton Edgar, reporting "several hundred cases in twenty-five years," prefers "pubiotomy in funnel pelves and contracted outlet, and in most cases with engaged head."

Theodore J. Doederlein, reporting about 20 to 30 cases, says:

"I perform pubiotomy in secondary cases; i.e., cases that have gone through the hands of midwives, etc. Cæsarean section in primary; that is, clean cases."

Carey Culbertson, reporting about 275 cases, prefers cæsarean section. He says that "pubiotomy should be complementary to cæsarean section, and not an operation to take its place. The field of pubiotomy is strictly limited."

*Treatment.* The induction of premature labor, at or after the thirty-sixth week, has much to commend it in certain cases; namely, where the contraction ranges from three and one half to three and seven-eighths inches, and where the circumstances are such that the child will have proper care and nursing. The induction of premature labor — undertaken not before the thirty-sixth week, under the most rigid aseptic technique — should have practically no maternal mortality, and while most authors place the fœtal mortality high, if the method be followed only in cases with a true conjugate of not less than three and one-half inches, and done from two to four weeks before the expected termination of pregnancy, the fœtal and maternal mortality, considered jointly, should compare favorably with the other methods of delivery.

Podalic version has been employed in contracted pelves, but it gives a high fœtal mortality, and if good maternal results are to be obtained, the procedure has to be undertaken soon after rupture of the membranes, before we have given nature sufficient time to see if she can effect delivery with the head presenting; therefore, if version be generally employed in this condition, many cases would be subjected to it, with a resulting high fœtal mortality, which, if left to nature, might terminate spontaneously.

If the contraction is below three and one-fourth inches and has been allowed to proceed beyond the point where premature delivery might have been most indicated, then cæsarean section is the operation of choice, if seen early enough; that is, before or at the beginning of labor and before the patient becomes exhausted and probably infected. If the true conjugate is three and one-fourth inches or greater and the head can be made

to enter the pelvis, then the patient should be given a test of labor at, or before, term, using extreme care to prevent infection and allowing reasonable time for the head to mold. If, after a reasonable test of the second stage, the head cannot be made to engage, with the patient in the Walcher position, then a trial may be made with the forceps, but great care should be exercised in their application and use, and if no progress is made after two or three attempts they should be left in position and a pubiotomy performed, after which delivery may be completed with the forceps.

Pubiotomy should never be selected as the operation of choice where it is apparent, before labor, that major surgical interference will be indicated, but in those cases that have been allowed to have a test of labor and cannot be delivered by the reasonable use of forceps, it is indicated if the mother and child are both in good condition. It is especially indicated in those cases where the head is impacted low in the pelvis and where the outlet is contracted.

In the event that cæsarean section is undertaken upon a case which is supposedly infected at the time, it will probably be better to remove the uterus at the same time.

Craniotomy upon the living child, if ever justifiable, is so in exceptional circumstances only, but if the child is dead and the contraction is not below two and one-half inches, it is the method of choice, provided delivery cannot be easily affected by version or forceps.

The tendency at present is to regard craniotomy upon the living child as never justifiable. This is a point which each one must decide for himself, but looking at it from a purely human point of view, it probably is justifiable in sections remote from trained surgical help, where both mother and child will probably die unless something is done. However, such instances must be rare in this country.

Some authorities believe in craniotomy, where a markedly hydrocephalic head is the cause of dystocia, and also advocate inserting the instrument to the base of the brain, in order to be sure that the child may be dead when born.

In such cases it may be justifiable to make a puncture sufficient to allow the fluid to escape, but to me it seems absolutely unjustifiable to go further, unless the exigencies of the delivery require it. It is not our province to rid the family of an undesirable member at this stage any more than it would be after its advent into the world.

## REFERENCES

KERR. Operative Midwifery.
WILLIAMS. Obstetrics.
HIRST. A Textbook on Obstetrics.
EDGAR. The Practice of Obstetrics.
SPEIDEL. Ky. M. J., 1913, xi, 465.
RONGY. Internat. J. Surg., 1912, xxv, 377.
REED, CHAS. B. Surg., Gynec. and Obst., 1913, xvii, 260.

# TRANSACTIONS OF SOCIETIES

## CHICAGO GYNECOLOGICAL SOCIETY

REGULAR MEETING HELD DECEMBER 19, 1913, WITH THE PRESIDENT, DR. FRANK W. LYNCH, IN THE CHAIR

DR. WILLIAM M. THOMPSON reported three cases as, follows:

CASE 1. Adenocarcinoma of the uterus. A woman aged 39, weighing 100 pounds, with a history of two miscarriages and three normal labors. Menstruation had been regular, and up to a year previously had lasted only one day. Four months before July 1, when she was first seen, she had been having intermittent hæmorrhages lasting about five weeks. For a period of the previous three months the hæmorrhage had been almost continuous. Physical examination showed an enteroptosis; the gynecological examination showed a pale, relaxed vagina and pelvic floor; the cervix was negative except for a stellate laceration; the uterus was the size of a six weeks' pregnancy at this and on three subsequent examinations. The cervix was hard and small; tubes and ovaries were negative; the body of the uterus was quite solid, and there could be felt in one corner a distinct mass. My diagnosis was between some retained decidua, although pregnancy was denied, and malignancy. I did a blunt curettement one day and a hysterectomy the next. The cervix was normal except for a bleeding vessel opening into the internal os, but up in the fundus was quite a mass, which presented a typical picture of adenocarcinoma of the fundus. The pathologist's report showed in the body of the uterus a fungating, bleeding, friable mass attached to the endometrium by a broad base. Sections through this mass showed no sharp line of demarcation between it and the tissue forming the muscular walls of the uterus.

CASE 2. A case of carcinoma of the intestine with chronic obstruction in a young girl aged 23, with no significant past or family history. Two weeks previous to being seen she had severe, sharp, intermittent pain in the stomach, with diarrhœa. Her physician had made a diagnosis of retroversion and put in a tampon. The pain continued, and the following day the menstruation came on; the pains were described as lancinating, extending clear up through the abdomen. She had had diarrhœa for a month, and at no time had a formed stool. Examination showed a tumor in the right iliac fossa extending up to the splenic flexure and across the abdomen above the umbilicus. This was a fœtal impaction. The uterus presented about an inch above the symphysis and was displaced forward. There was a bulging of Douglas' pouch. A median incision was made and a tumor extending throughout the whole length of the pelvic sigmoid was found. The tumor lay behind the uterus. There were no adhesions, but some metastases in the peritoneum. The mesentery was so long that it was easily possible to raise the tumor through the abdominal wall. The method used was to excise the tumor three inches above the mass and about three inches below and amputate the mesosigmoid. Into the upper end of the bowel a rubber tube 1½ inches in diameter was passed and fastened with a purse-string suture, one stitch going through the tube. The other end of the tube was passed through the distal end of the bowel and out through the sphincter, and thus the upper end was invaginated into the lower and united by interrupted sutures. The sphincter was dilated. About six inches above the resection a lumbar colostomy was performed by the two-step method. On the second day the colostomy was opened with the cautery, a large catheter was passed into the transverse colon and warm olive oil injected, for four days. At the end of four days the woman had an enormous bowel movement, weighing about five pounds. The colostomy gradually closed.

The pathological report was as follows: Chronic obstruction; carcinoma of the sigmoid flexure; ulceration, the edges of the ulcer being composed of connective tissue, with which are found very small masses of epithelial cells. The masses extend in the submucosa far underneath the normal mucosa, and in many places the degeneration left large masses of mucus with a few pale nuclei here and there. Carcinoma of the sigmoid.

CASE 3. A large, vigorous woman weighing, in July, 1912, 190 pounds; 35 years of age; a widow with no children. Menstrual history was regular until two months before the time of consultation, during which she had flowed two weeks and stopped, had begun again, and was flowing at the time of consultation. She had four sisters, all of whom had been operated on for pelvic disease, but none with infection. They had either fibroid tumors or ovarian tumors and procidentia. The woman complained of prolapse of the womb. The abdomen was large; there was fluid in the flanks, and a large tumor reaching half way between the umbilicus and the ensiform. The tumor had the consistency of a cystic myoma — more solid than otherwise. The cervix presented at the vulva.

She was operated on July 18, and the tumor removed, with the ascites. The tumor was called in the operating room a pseudomucinous cyst of the left ovary. It was attached to the omentum at its lowest point and the omentum was excised two or three inches above the attachment. The woman did well for a year, and then she reappeared. The pathologic report showed a cyst having a capacity of about 500 ccm., with many small cysts in the wall extending into the cavity. The cysts contained substances of varying character — the largest of a thin, clear character, a smaller one of a mucoid character, and one of a thick caseous material containing hairs. The microscopic preparations showed papillomatous cystadenoma with epithelium, hair, and adipose tissue. The upper part was a pseudomucinous cyst; the lower part was a solid cyst and contained dermoid material.

The second time I saw the patient she had an enormous abdomen with a great deal of ascites and complained of a return of the prolapse. I opened the abdomen and there appeared to be a carcinomatous mass in the omentum. At the same time epithelial papillæ were dotted all over the

parietal and visceral peritoneum, and masses of papilla floating in the fluid. The abdomen was closed after removing the omentum almost entirely, leaving a portion in the region of the splenic flexure, and fixing the uterus to the abdominal wall. The woman was put back to bed and given over to X-ray treatment for a while. That was the last of June. The pathologist's report was that the specimen consisted of a tumor mass about the size of a hen's egg embedded in a mass of omental fat covered with smooth, shining peritoneum. The cut-surface shows a fatty tissue striated with grayish white fibrous tissue.

Histologically this section consists of an areolar fatty tissue containing within it trabeculæ of connective tissue of a cellular type in some places almost resembling spindle-celled sarcoma. Within this convertive tissue, which varies greatly in amount in various places, are found epithelial masses in the form of acini of exceedingly variable shape and size, in some places lined with multiple layers of epithelium of cuboidal type — metastatic carcimona of the omentum.

The next time she appeared, in April, the X-ray man found the tumor mass in one side had been reduced. I advised against operation. In October she returned with a urethral caruncle, ascites, and umbilical hernia. The caruncle was removed and the woman put to bed. This specimen was large like a polyp. It consisted largely of granulation tissue in which there was found a mass of squamous epithelium, irregular in outline, the tissue cells containing many mitoses. Urethral caruncle; carcinoma (?).

At the next operation, in January, the right ovary was removed, which at first operation was normal. It was found to be carcinomatous, about the size of a large orange. The carcinoma in the splenic flexure was smaller, and the small papillæ of the peritoneum were also smaller and were hard instead of soft.

This woman undoubtedly had carcinoma in the first cyst, that had been overlooked. It is a matter of common knowledge that the majority of cystic ovarian teratomata are innocent tumors, while on the other hand solid ovarian teratomata are of intense malignancy, invading surrounding structures and giving rise to metastatic deposits. Up to 1912 there had been nineteen similar cases reported.

DR. N. S. HEANEY reported the case of birth of a monster in a woman aged 33, who had always been extremely healthy, and was pregnant for the first time after six years of married life. The husband had a living healthy child 12 years old, from a previous marriage. The patient felt unusually well during pregnancy until the twenty-eighth week. The uterus had corresponded in height with the period of amenorrhœa until the twenty-eighth week, when there was a rapid increase in size, associated with marked pain. Heart sounds of one fœtus only were found. Because of the frequent association of twins and fœtal anomalies with hydramnios, an X-ray was taken by Dr. Potter. The picture showed one fœtus, which was very small for the thirtieth week. The vertebræ and femurs were plain, but no cranium showed. The patient, two days after the examination, suddenly had a gush of water and delivered herself within twenty minutes. (The product of conception was exhibited.)

Examination of the female fœtus shows a multiplicity of abnormalities: It is an exencephalus; the brain lies entirely free, the cranial vault being absent; only one eye is present, the brain protruding through the other orbit; the nose is only a little bud; the cord is adherent to the brain membranes; the left arm is adherent to the neck of the fœtus; the right arm is short and markedly deformed; the heart, liver, intestines, spleen, in fact, most of the abdominal organs lie outside of the abdominal cavity; also there is double club-foot. It was born dead.

DR. EUGENE CARY, in discussing Dr. Heaney's case, asked whether the chorion and amnion were attached. Dr. Heaney said that as far as could be made out macroscopically they were attached. The amnion could not be separated from the chorion in the parts examined.

Dr. Cary said he had asked the question because, on the head of the fœtus where the cord is attached to the brain and on the side of the neck where the arm which shows the greatest deformity was attached, there seemed to be a kind of membranous band. It is interesting to note that in several cases with malformations of the fœtus which have been reported by Stechel, who has collected 12 cases, the amnion was ruptured and there were found a number of adhesions of the amnion to the fœtus; and he and others believe that that is caused by the adhesion of the amnion, and in this case that may explain these abnormalities. Dr. Heaney's case is also of interest because there have been only three or four cases in which abnormalities of the fœtus associated with hydramnios were found. He had a case to report also in which hydramnios was responsible for the condition, but there were no malformations; but in the case reported by Ahlfield, hydramnios was responsible for club-foot, and in two or three other cases hydramnios caused some malformation, but in none of them were any adhesions found.

DR. HEANEY: The chronic hydramnios of the last weeks of pregnancy is not associated with a high percentage of fœtal abnormalities, while the so-called acute hydramnios of the earlier months is so frequently associated with abnormalities of some sort — hydrocephalus, spina bifida, anencephalus, exencephalus, and deformities of the upper part of the central nervous system — that it is inadvisable to make especial attempts to prolong pregnancy. The earlier the hydramnios occurs the more frequent and greater the percentage of fœtal anomalies.

DR. REED: I should like to ask Dr. Carey if some recent development in histology has discovered the covering of the cord to be amniotic. My idea was that there was no amniotic covering of the cord.

DR. CARY: Not that I know of. I had in mind where the amnion reflected up on the cord from the placenta.

DR. ARTHUR H. CURTIS read a paper on "Bacteriology of Leucorrhœa" (see p. 299), and exhibited microphotographs and microscopic slides of the bacteria found in leucorrhœa.

DR. T. J. WATKINS: My ideas have changed materially in regard to this subject since Dr. Curtis has been making these examinations. It has been a source of surprise to find how few of these patients had any discharge from the uterus. The majority had a discharge of clear mucus from the cervix, occasionally a thick yellow plug.

The study in regard to the reactions of the discharge would seem to show that what has been written in regard to the vaginal and uterine cases is chiefly imaginative. Practically nothing of any interest has been found in the discharge relative to reaction. They are practically all acid, some rather weakly acid or nearly neutral.

It would also seem that much that has been said in regard to the relation between the general elimination, anæmia, and vaginal leucorrhœa is a matter of guess-work rather than of accurate observation. Many of these patients are in good physical condition, with good elimination, and attention to the eliminative organs has had practically no effect on the leucorrhœa.

The question of diagnosis is interesting. I find that heretofore I have been considering many of these cases gonorrhœal which were not. We were fortunate in having a number of cases in which there had been no gonorrhœal infection (in all these cases we have had conferences with the husband), and I know in some of these cases the husband has had no gonorrhœa, and there has been no suspicion that the wife had gonorrhœa; and yet these cases, diagnosed according to the superficial methods of examination heretofore used, would be pronounced gonorrhœal cases. In the diagnosis we have had no cases in which the examination of Skene's ducts has been of much service. In only a small number was a discharge found in Skene's ducts, and we occasionally found gonococci in these. It is difficult to determine what is a normal Skene's duct and what is an infected duct. These investigations also show that an examination microscopically of the discharge, to see whether the gonococci have disappeared, is of no use, because the gonococci disappear in all cases, irrespective of treatment.

DR. C. S. BACON wished to ask Dr. Curtis whether all these examinations had been made on non-pregnant women or whether some of them included leucorrhœa in pregnant women; and also whether he had attempted to classify the discharges according to their physical characters into more or less liquid or fluid discharges and thick, cheesy discharges, and if so whether the flora differ in the different kinds of discharges.

DR. HEANEY wanted to ask whether this had been a study of the vaginal secretions, or a study of cases of leucorrhœa, or did Dr. Curtis distinguish between cases of leucorrhœa and excessive vaginal secretion. Is it required that a smear have a leucocytic content in order to call it leucorrhœa, or does the intensity of the secretion, if otherwise normal in character, constitute a leucorrhœa? For instance, we may find in chlorotic young girls a secretion intense enough to stain the clothes, but which does not contain leucocytes or other apparent abnormalities. Dr. Heaney was surprised at the few cases in which Dr. Curtis found a visible purulent discharge from the cervix microscopically showing leucocytes. Where does the vaginal secretion come from? Is it mucus from the cervix that is altered in the vagina by organisms, or is it an exudate from the vaginal walls?

DR. GOLDSPOHN said he had held the thought expressed by the last speaker, that we need to recognize a more or less physiologic discharge that is not at all the result of infection; and if they are copious they may become impregnated with certain bacilli, such as the Döderlein, as a physiological or normal condition. Many women and young girls have what is called a catarrhal condition, a rather excessive vaginal and cervical secretion, perhaps intra-uterine. If there is no such thing as an intra-uterine discharge, he should be glad to learn that fact. But he would like to know whether there is not such a thing as a physiologic discharge that may become excessive under certain conditions, as pelvic hyperæmia induced by sedentary employment, by insufficient menstrual discharge, by sexual excitement, or by displacements. He had repeatedly seen a leucorrhœa stopped by righting a retroverted uterus. In regard to the gonococcus, that prepares the way for many affections, chiefly among those who have been pregnant. Whether it is the right thing to teach that as long as we can find the gonococcus under the microscope we should not interfere with nature's processes, and after it is no longer recognizable by the microscope we should institute our surgical relief, is a question.

DR. ROBERT T. GILLMORE said in regard to treatment, which Dr. Curtis had just touched in regard to bacterin therapy, we all know of the treatment by silver salts and the persistency of these leucorrhœal discharges, and how useless it is to give douches; he would like to know where

Dr. Curtis obtained his autogenous material, and also whether he has had any results with the Bulgarian bacillus in these cases.

Dr. Curtis, in closing, said it was difficult to classify all these infections according to whether the woman is pregnant, whether she had gonorrhœal infection, whether it was a mucous discharge, a purulent discharge, or no discharge. He had studied only 85 cases, and had hoped merely to open the way to a study of the trouble from which something of practical value might be developed. A small amount of discharge exists in every woman, whether married or not; this consists of a small amount of transudate and epithelial cells, together with the Döderlein bacillus, which is normal. As soon as there is a mucous discharge there is a pathological condition. His subject was chronic leucorrhœal conditions, which he attempted to limit to purulent discharges which contained leucocytes. He did not discuss cases in which there was a discharge from the cervix due to hypertrophy, erosion, or eversion. Mucus makes an excellent culture medium. A woman with such a discharge has an increase of the normal Döderlein bacilli, with complications depending on the amount of discharge and the amount of accompanying inflammation, extending through all gradations up to a profuse purulent discharge which is characteristic of marked cases of leucorrhœa. He had not formed any opinion about women who are pregnant. The cheesy discharges come from virgins, and usually contain the Döderlein bacillus only. Leucocytes are unusual. During menstruation, the only difference is that there is an increase in the culture medium and a temporary increase in the organisms. Examination of the mucus plug in the cervix for leucocytes gives little information of value, because of the tendency to contamination from pus-covered adjacent vaginal walls.

With Dr. Gillmore's permission, it seemed best to postpone all discussion of treatment until it can be taken up in detail.

---

# BOOKS RECEIVED

Books received are acknowledged in this department, and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

Principles of Surgery. By W. A. Bryan, A. M., M. D. Price, $4.00 net. Philadelphia and London: W. B. Saunders Company, 1913.

An Introduction to the History of Medicine. By Fielding H. Garrison, A. B., M. D. Price, Cloth, $6.00. Philadelphia and London: W. B. Saunders, 1914.

Surgical Diseases of Children. By Samuel W. Kelley, M. D., LL. D. Price, $5.00. New York: E. B. Treat & Company, 1914.

Anatomy and Physiology — A Textbook for Nurses. By John Forsyth Little, M. D. Price, $1.75 net. Philadelphia and New York: Lea & Febiger, 1914.

Precis de Radiologie Pratique. By André Lomon and Camille Hahn. Paris: Société d'Editions Scientifiques et Médicales, F. Gittler, Directeur, 1913.

The Human Body and Its Enemies. A Textbook of Physiology, Hygiene, and Sanitation. By Carl Hartman, B. A., M. A., and Lewis Bradley Bibb, B. A., M. D. Price, 65 cents. Yonkers-on-Hudson, New York: World Book Company, 1913.

Report of the Proceedings of the English-Speaking Conference on Infant Mortality. Price, 3s. net. London: National Association for the Prevention of Infant Mortality and for the Welfare of Infancy, 1913.

First Book of Health. By Carl Hartman, B. A., M. A., and Lewis Bradley Bibb, B. A., M. D. Price, 65 cents. Yonkers-on-Hudson, New York: World Book Co.

The Principles and Practice of Gynecology. By E. C. Dudley, A. M., M. D. Price, $5.00 net. Philadelphia and New York: Lea & Febiger, 1913.

On Diseases of the Rectum and Anus. Including the Sixth Edition of the Jacksonian Prize Essay on Cancer. Fourth Edition. By Harrison Cripps. F.R.C.S. Price, $3.25. New York: The Macmillan Company, 1914.

Diseases of Women Medical and Surgical Gynecology. By Charles A. L. Reed, A. M., F. C. S., M. D. New York and London: D. Appleton and Company, 1913.

A Treatise on the Diseases of Women. For Students and Practitioners. By Palmer Findley, B. S., M. D. Price, Cloth, $6.00, net. Philadelphia and New York: Lea & Febiger, 1913.

Surgery of the Upper Abdomen. By John B. Deaver, M. D., Sc. D., LL. D., and Astley Paston Cooper Ashhurst, A. B., M. D. Price, $5.00. Philadelphia: P. Blakiston's Son & Company, 1913.

Tumors of Abdominal Viscera. By Professor Rudolph Schmidt and Joseph Burke, Sc. D., M. D. Price, $4.00. New York: Rebman Company.

Surgery of the Vascular System. By Bertram M. Bernheim, A. B., M. D. Philadelphia and London: J. B. Lippincott.

Genito-Urinary Diseases and Syphilis. By Edgar C. Ballenger, M. D. Price, $5.00. Atlanta, Ga.: E. W. Allen & Co.

The Stomach and Œsophagus. By Alfred E. Barclay, M. A., M. D., B. C., M.R.C.S. London: Sherratt & Hughes.

The Surgical Clinics of John B. Murphy, M. D. Philadelphia and London: W. B. Saunders Company.

# BOOK REVIEWS

THE SURGERY OF THE STOMACH. Herbert J. Patterson, M. D. New York City: Wm. Wood & Co.

A review of this work of Patterson's has been one of the pleasures that seldom comes to those who make a discriminating study of books for the subject of review.

It is seldom that one finds a subject so clearly and concisely set down as is here done. There is little or no extraneous matter, the author discusses the work from a broad standpoint, yet at no place is there suggestion of verbosity. It was prepared for the printer too early for a comprehensive discussion of the use of the X-ray in the diagnosis of obscure lesions, but otherwise the student will find a complete résumé of the diagnosis and treatment of the various lesions, of the stomach.

Of especial interest is his discussion of anterior gastrojejunostomy, which has to a certain extent fallen into disrepute in the United States. His able defense of this procedure will serve to stimulate us to further investigation. One concurs with him in the advocacy of the wide incision in every case in which the stomach is to be operated upon, for the sake of careful examination of the entire abdominal viscera.

The author is not an advocate of the various types of gastropexy in gastroptosis, and one would like to have had a more extensive discussion of the subject than the author sees fit to give. As is natural, the larger portion of the book deals with the subject of gastric and duodenal ulcers with their complications. The value of this has been much enhanced by the extensive bibliography accompanying the various chapters.

In the after-treatment the early feeding of the patient by mouth is urged and severe condemnation given to rectal feeding.

One reads with pleasure the chapters on duodenal and gastroduodenal ulcer in which the author, because of his careful observations and study of these cases, is particularly competent to speak.

The chapter on infantile pyloric stenosis gives the English rather than the American view of this condition in that he advises conservatism with operation as a last resort. The good results obtained by American surgeons in this class of cases leaves no doubt in our minds that surgical intervention should be the proper procedure. The large series of cases by our own Scudder and Richter seem to have proven this.

It is a pleasure to recommend this volume to every surgeon. It should be in the hands of every one who wishes to keep abreast of the best thought in gastric surgery.

PRECIS D'ANESTHESIE LOCALE. Préface de M. le Prof. Reclus. By A. Piquand, Ancien chef de Clinique à L'hôtel-Dieu de Paris. Société d'Editions Scientifiques et Médicales.

This volume, designed for practitioners and students, is clear and precise, and while essentially technical is thoroughly comprehensible and advocates local anæsthesia for many operations which previously have not been attempted except under a general anæsthetic.

The first three chapters deal with indications and contra-indications for local anæsthesia, anæsthetic agents, and their chemistry. Technique in general is fully discussed in subsequent chapters, also the special technique employed in the various regions of the body, these being amply illustrated.

This book will be welcomed, not only by the student of local anæsthesia but by the surgeon who, not having mastered the technique, is prone to belittle the possibilities of local anæsthesia and employ a general anæsthesia many times to the detriment of the patient.

H. A. POTTS.

SYPHILIS AND THE NERVOUS SYSTEM. By Max Nonne, M. D., Hamburg, Eppendorf. Translated by Charles R. Ball, B. A., M. D. Philadelphia: J. B. Lippincott Co.

The second edition of Nonne's text "Syphilis and the Nervous System" is an up-to-date review of the latest investigations on this interesting subject. However, there is no question but what this text has lost in value from the mere fact that it is a second edition. The former book was written prior to the discovery of the Wassermann reaction, and also prior to Ehrlich's work on "The Chemo-Bacterio-Tropic Therapy." These two important discoveries would of necessity require a complete new text on the therapy and diagnosis of syphilis of the nervous system, and Nonne has only revised his text on these matters. However, it is splendidly written. The inductive method of arranging the work is particularly attractive. The chapter on the pathology of syphilis could scarcely be improved upon. The chapter wherein the arguments for and against the theory that tabes can only be produced by syphilis is one which is a revelation to the average practitioner.

Nonne has also taken up the discussion of hereditary syphilis, behavior of the Wassermann reaction, prophylaxis, salvarsan therapy, the relationship of dementia paralytica to syphilis, and has given us splendid work on each of these subjects. His text is splendidly illustrated throughout, especially that part relating to the pathology of nervous syphilis.

TREATMENT AFTER OPERATION. By William Turner, M. S., F. R. C. S., and E. Rock Carling, B. S., F. R. C. S. London: University London Press, 1912.

This rather brief work is intended for the general practitioner and the house surgeon. The authors place before you in a brief way certain principles regarding the care of a patient following a surgical operation. They make no pretense to methods employed by other men, but quote only their own experiences.

Practically every subject is dwelt upon, although some of them in a very inadequate way, leaving much to the imagination of the reader.

In discussing abdominal surgery, the chapters begin with an enumeration of the various operations; following this each one is taken briefly into consideration, outlining the ordinary care and the possible complications that might arise and how they should be dealt with.

The later part of the work consists of a rather detailed chapter on the eye by L. V. Cargill, F.R.C.S. This chapter takes up much more detail than the preceding chapters, minutely giving technique and dressings. This gives the work a peculiar unbalance which is displeasing to the reader. J. A. WOLFER.

DISEASES OF THE RECTUM AND PELVIC COLON. Martin L. Bodkin, M. D. New York City: E. B. Treat & Co.

The author has handled the subject in a thorough, practical, and inductive method. We are first given an anatomical and physiological description of the rectum and surrounding structures, which is indeed very necessary to a thorough understanding of the pathological changes in this organ.

Next the general examination, general diagnosis, and general symptoms are consecutively taken up. Malformations, catarrhal diseases, sigmoiditis, proctitis, and the many other pathological changes, are discussed. Following this, the special operations are given, together with such consideration of medical treatment as its importance merits. There is a special chapter discussing the relationship of rectal diseases to gynecology, which is of interest and value. It is impossible to review in detail in the small space allotted the many valuable features of this work. It must be sufficient to say that it is complete, not so voluminous as to be cumbersome, and very clearly and intelligently written.

TUBERCULIN IN DIAGNOSIS AND TREATMENT. F. M. Pottenger, A. M., M. D., LL. D. St. Louis: C. V. Mosby Company.

Dr. Pottenger has devoted this little volume to the defense of tuberculin. The discussion which has continued since its memorable incipiency by Robert Koch is still continued. Pottenger makes you feel that he would like to discontinue it and come out as an enthusiastic champion of tuberculin, yet in every chapter he gives way to doubts and discussion, often inserting contradictory statements by other well-known authors. However, the text is, as its name implies, devoted to a consideration of the value of tuberculin in diagnosis and treatment, and as such mirrors wide exeprience and painstaking care. It is well written in language and argument that is easily understood. The author tells us to be circumspect and not accept negative tuberculin tests in face of other positive clinical findings. We are informed very intelligently as to the classes of cases suitable for tuberculin treatment and cautioned in every case to make use of all other therapeutic measures which are known to be of value.

The technique of administration, dosage, choice of preparation, method of dilution and preparation occupy at least one-third of the book and form an excellent working guide for the clinician who administers this much discussed and abused remedy.

COLLECTED PAPERS BY THE STAFF OF ST. MARY'S HOSPITAL, MAYO CLINIC. Contributions by twenty-three different surgeons. Philadelphia: W. B. Saunders Company, 1913.

The student of surgery in the future will refer with great frequency to the various classes of surgical papers that have emanated from the Mayo Clinic. The present volume contains some of the most valuable contributions that have been published by the Mayo Clinic in the last few years. The ripened surgical experience of the Mayos has been supplemented in these volumes by many articles dealing with questions of surgical practice. They have fortunately turned their attention to clearing up some of the moot questions by extensive study of their cases as exemplified by the articles of MacCarty and others.

It is seldom that one can say, as may be said here, that every article in the volume is of pre-eminent importance, since there is no chaff but all wheat. We wish to congratulate the Mayos, not alone because of the great work they are doing in their clinics but because of their careful method of history taking and examination, which have made possible the presentation to the public of the experience they have gained at the operating table.

CHEYNE & BURGHARD'S SURGICAL TREATMENT, VOLUME V. By Sir W. Watson Cheyne, Bart., C. B., D. Sc., LL. D., F. R. C. S., F. R. S., and F. F. Burghard, M. S., F. R. C. S. Philadelphia and New York: Lea & Febiger.

The last volume of this series by Cheyne and Burghard includes the treatment of the surgical affections of the pancreas, liver and spleen, the neck, larynx, breast, and thorax, and the genito-urinary organs, including the kidneys.

It is a work intended to meet the demands of the practitioner rather than the student. Only enough space is devoted to the symptoms and pathology to render more intelligible the principles upon which the treatment is based and the various stages of the disease to which each particular method is applicable.

There is a tendency throughout this text to indicate and discuss at length only one method of treatment, although other methods are frequently mentioned. This innovation of relieving the practitioner of the burden of reading discussion of many different methods of accomplishing the same result should be appreciated, for it is indeed rare among the compilers of systems of surgery.

The illustrations are simple but useful, and it is to be regretted that many important points are left without illustrations where the use of them would greatly assist the reader to a more complete conception of the text.

The book, intended for the guidance of the practitioner, is very complete in detail with the possible exception of the portion devoted to after-treatment. This is one of the most important steps of surgery and it should be discussed clearly, simply, but fully, since upon the after-treatment depends to a large degree the successful termination of operation.

PYE'S SURGICAL HANDICRAFT. Edited and rewritten by W. H. Clayton-Greene, B. A., M. B., B. C., F. R. C. S. New York: E. B. Treat & Co.

There has been much added to this most excellent work, bringing it fairly well up to date. The subject of syphilis has been elaborated to include the technique of the Wassermann reaction and the salvarsan treatment.

It is indeed difficult to select any one part as the best. As the name of this work implies, it deals in those very important details of surgery which require some ingenuity and acquired skill. Many minor points which are so essential to the young surgeon are discussed in such a logical and concise manner that it becomes a pleasure to read it.

The subject of splints and various appliances for the treatment of fractures and sprains is clearly outlined and illustrated, and is well worth any surgeon's time to read.

The various minor surgical topics which confront the house surgeon, such as ulcers, frostbite, burns, abscesses, sprains and the various urinary disturbances and the like, form a chief part of the scheme of this book. It is so common in the ordinary texts of surgery to find these very important subjects briefly and inefficiently discussed that it gives this work a distinct position in the surgical literature.

Those diseases which require long and persistent treatment, with at times special appliances, such as vertebral caries, and tuberculosis of joints in general, are given a rather prominent place. The eye, ear, nose, and throat are also discussed in a very pleasing and efficient manner. The teeth, regarding which the surgeon knows so little, are also included. The treatment of different forms of poisoning, drowning, and other forms of suffocation are also given due consideration. The formulæ for enemata and various fementations are taken up in a logical manner.

After a careful reading of the book one must truthfully say that it fills a quite unique place in the library of the surgeon and an indispensable place in the hands of the student, the young practitioners, and the house surgeon. J. A. WOLFER.

DISEASES OF THE STOMACH. George Roe Lockwood, M.D. Philadelphia and New York: Lea & Febiger.

The author states that it is his intention to describe the diseases of the stomach as he has seen them and to present them from the standpoint of personal experience, and for this purpose he has grouped series of cases and analyzed them. He has faithfully carried out his purpose. The volume as presented is a most valuable one to the student and gastric surgeon. It is much more comprehensive than the ordinary text-book that one would expect to find as the result of personal experience, since it is a volume of over six hundred closely printed pages. This has given the author a chance to discuss each of the various symptoms, signs, and conditions in detail at great length, and consequently the volume will be found of special value to the beginner in this special field of surgery, although it can be read with profit by anyone.

Because of its extensive discussion it should be considered a book rather than a monograph. The student will find it a means of ready reference in the various conditions confronting him.

GYNECOLOGICAL OPERATIONS, INCLUDING NON-OPERATIVE TREATMENT AND MINOR GYNECOLOGY. Henri Hartmann, M. D. Translated from the French by Douglass W. Sibbold, M. D. Philadelphia: P. Blakiston's Sons & Co.

In the preparation of this work, the author has endeavored to give a complete exposition of the diverse methods of treatment employed in gynecology. Non-operative treatment is fully considered, as there is a general return to this branch of therapeutics. For this reason, much space has been devoted to minor gynecology, mineral water cures, kines therapy, and electrotherapy. Special attention has been given to procedures of choice and to the large number of figures and diagrams, in an endeavor to clearly illustrate each stage of the various operations. Throughout the whole text the author has shown painstaking exactitude in every detail of the varied divisions of his subject. Nothing better can be said of this text than the following extract from the *British Medical Journal* in its review, "It is for the opinion of this experienced authority on disputed questions that the reader will most probably search his pages."

INTRODUCTION À LA CHIRURGIE UTÉRINE OBSTETRICALE. By A. Couvelaire, Assistant Professor, Faculty of Medicine, Paris. Paris: G. Steinheil.

This work is divided into two parts: first, the surgical anatomy of the uterus at term, during and after labor; and second, conservative surgery of the uterus at term and in labor. It consists in a series of plates, illustrating various phases of the uterus in pregnancy and in obstetrical operations, each plate

being accompanied by explanatory text. In Part I, these plates, for the most part, are photogravures in sepia, each accompanied by a line drawing to aid in definition. The rest of the plates are half-tone reproductions of wash drawings.

Part II consists of a fairly complete text, with bibliography, describing the major surgical procedures involving the uterus in pregnancy, chiefly the extra- and transperitoneal cæsarean section and vaginal hysterotomy. This is also illustrated by full page plates in half-tone.

The work is based upon preparations in the Baudelocque Clinic specimens dating back to the time of Champetier de Ribes and Varnier, the surgical preparation having been made under the direction of Pinard. The feature of the volume consists in the plates, the author having been fortunate in securing the services of so accomplished an artist. The photogravures are not only scientifically exact but exquisite in creation and most skillfully reproduced.

CAREY CULBERTSON.

NEW ASPECTS OF DIABETES. Pathology and Treatment. Professor Doctor Carl von Noorden. New York City: E. B. Treat & Co.

These lectures delivered at the New York Post-Graduate School upon diabetes give the present conception of the relation of diabetes to the other organs, as well as being an intrinsic discussion of the disease itself. While they do not cover the entire field they are of particular value in relation to the questions of modern research. The author considers that nervous influences stimulate the adrenals to an increased production of epinephrin, while the thyroid and hypophysis on the other hand are supposed to act by depressing the pancreas. These more or less theoretical deductions, while worthy of consideration, really add little to the definite understanding of this disease. The author lays particular stress upon the slight importance of glycosuria in certain phases of the disease. The chapter upon acetonuria will be found very suggestive.

MARRIAGE AND GENETICS, LAWS OF HUMAN BREEDING AND APPLIED EUGENICS. By Charles A. L. Reed, M. D., F. A. C. S. Cincinnati: The Galton Press, 1913.

As set forth in the introduction, the objects of this volume are "to overcome the ignorance which in too many instances keeps innocent victims from protecting themselves and their offspring from disease and degeneracy, to avert many of those conditions that destroy the possible happiness of the marriage state, and convert the bridal chamber into the anteroom of the divorce court." While covering an enormous field, the author has compiled a brief and concise statement of the principles underlying race betterment, and that, too, without subjecting his reader to that moralizing and sermonizing which are so obvious in most popular treatises on this subject. It is written in terms for the lay reader, yet the subject-matter is so well formulated as to be attractive to the scientist desiring some systematic expression of the theme. Thus the doctrines of Lamarch and the discoveries of Mendel, of Weismann and of DeVries, together with Galton's laws are carefully set forth, together with the author's series of ten fundamental laws of race perpetuation, designated as the decalogue of human breeding." In the immense amount of material recently produced on topics relating to marriage and sex hygiene, this volume stands out as a definite expression to perform a definite service.

CAREY CULBERTSON.

TEXTBOOK OF GENERAL AND SPECIAL PATHOLOGY FOR STUDENTS AND PRACTITIONERS. Henry T. Brooks, M. D. Philadelphia: F. A. Davis Co.

In the present-day making of books, we are having a large number that are really compilations of previous treatises, either in our own or some foreign language. It is a question as to how valuable such a book may be, although this is a translation of the work of Langerhans, which has been amplified by taking up the later developments in the field of pathology since the death of Langerhans. It is a concise and necessarily, therefore, to a certain extent unsatisfactory pathology. This book may be recommended generally, although if one searches for a special thing he is likely to find himself somewhat disappointed. The illustrations are mostly copied from other textbooks, particularly from the German, and many of them are in color.

INFECTION AND IMMUNITY. By Charles E. Simon, B. A., M. D. Philadelphia and New York: Lea & Febiger.

The day of the medicine bottle and the tablet box having passed, our attention is attracted toward the more scientific and theoretical methods of treatment, immunology and vaccine versus serum therapy. Shortly the physician's drug store may be carried around in a little pocket case labeled "vaccine and serum." However, a recent observation of Ehrlich would seem to indicate that in his opinion even the vaccinists and serum therapists have reached the limit of their usefulness. He recommends that more advancement be made along chemo-bacterio-tropic lines. The vaccine and serum therapists in turn say that the medicine internists of the old school never did cure anything with drugs except malaria and syphilis, and that all advancement along specific therapy has been by themselves.

Simon writes on the various phases of immunology and serum therapy with striking brilliance, and it can be said without contradiction that his second edition is the most thoroughly up-to-date and reliable book yet written in English on this subject.

There are very interesting chapters on the offensive forces of the invading micro-organisms, and the defensive forces of the macro-organism, chemeotaxis, the side-chain theory, anaphylaxis, active immuniza-

tion, serum therapy, and the methods of demonstration are discussed wherever applicable. A generous space is devoted to the diagnosis and treatment of tuberculosis. The text contains many splendid illustrations.

ABWEHRFERMENTE DES TIERISCHEN ORGANISMUS GEGEN KÖRPER, BLUTPLASMA- UND ZELLFREMDE STOFFE, IHR NACHWEIS UND IHRE DIAGNOSTISCHE BEDEUTUNG ZUR PRÜFUNG DER FUNKTION DER EINZELNEN ORGANE. Von Emil Abderhalden. Berlin: Verlag von Julius Springer, 1913.

This second edition of Abderhalden's investigations concerning the ferments of the plasma and cell substance is, of course, of special interest to all those interested in the scientific side of this question, which undoubtedly in the future will be placed upon a much firmer basis than it is at the present, and it is to be hoped that organotherapy along this line will be removed from the uncertainty which now accompanies it and that we may employ it with the hope of sure results. The author discusses in a comprehensive manner the ferments formed by the white and red corpuscles, blood and tissue cells, and lymph action. He discusses in detail serum of pregnant women, its value in determining pregnancy, and other questions of a like nature.

DISEASES OF WOMEN. Enlarged and Revised Edition. George Ernest Herman, M. B., F. R. C. P., F. R. C. S. Assisted by R. Drummond Maxwell, M. D., F. R. C. S. New York City: Funk & Wagnalls Co., 1913.

This comprehensive text on the diseases of women, for many years one of the most authentic in the British Empire, is now in its fourth edition. The author, long a leading clinician, produced a work which in its early form showed considerable variation from the conventional text. His original aim, as frankly set forth, was to provide a book which "should guide the student and practitioner to the diagnosis and right treatment of the diseases of women." Without regard to anatomical classification, he endeavored to present the different organic affections in the way in which they appeared in practice. Thus the work was classified according to symptoms, a scheme which has some definite advantage from a purely clinical point of view, if confusing to the reader accustomed to the commoner anatomical arrangement. Hence after a few introductory chapters, chronic pelvic pain is discussed, then pelvic inflammation, and next internal hæmorrhage. Part V takes up hæmorrhage in general and is followed by five short chapters on leucorrhœa. The disorders of menstruation and of the sexual functions come next, followed by urinary and rectal complications. The volume concludes with a complete presentation of abdominal tumors.

This arrangement is continued in the new edition, diagnosis and treatment again being emphasized. The greatest change in the present volume is seen in the parts relating to operative technique, the portion of the work revised by Dr. Maxwell. Thus in the plastic work of the cervix and vagina, and in radical extirpation for malignancy, as well as in many other instances, the revision has added greatly to the value of the book as a text.

Many of the illustrations are new, including eight in color. Another excellent feature is the index, divided into two parts, a general index and one of authorities, each much amplified.

CAREY CULBERTSON.

A MANUAL OF X-RAY TECHNICUE. A. C. Christie, Captain, Medical Corps, United States Army. Philadelphia & London: J. B. Lippincott Company.

This manual by Christie is a condensed text on the application of X-rays in diagnosis and treatment. The book may be found very useful to the physician and surgeon in private practice, especially so to those who are in the rural districts and who find it necessary to do their own radiography. One commendable feature of the book is its brevity and conciseness. X-ray operators are urged to make themselves familiar with the use and construction of the different forms of X-ray machinery and are shown the simplest methods for obtaining the best results. A careful study of this little manual will greatly aid the operator in becoming proficient in this branch of diagnosis and treatment.

LEHRBUCH DER PRAKTISCHEN CHIRURGIE FÜR ÄRZTE UND STUDIERENDE. L. Gelpke, M. D., and C. Schlatter, M. D. Leipzig: Johann A. Barth, 1913.

This work, appearing in two volumes, is designed for both student and practitioner. The text is relatively short, yet complete and comprehensive and arranged in a logical manner, facilitating ready reference. Various theoretical problems are omitted, giving way to practical descriptions of surgical conditions and their causative factors, together with explicit suggestions as to treatment. The first chapters are devoted to the principles of general surgery, including injuries, acute and chronic infections, and tumors, and the following chapters are devoted to regional surgery. Many of the latest advances in surgical treatment are given, which bring the work up to date.

H. A. POTTS.

SURGERY, GYNECOLOGY AND OBSTETRICS

AN INTERNATIONAL MAGAZINE, PUBLISHED MONTHLY

VOLUME XVIII APRIL, 1914 NUMBER 4

# RESECTION OF THE RECTUM FOR CANCER WITH PRESERVATION OF THE SPHINCTER[1]

BY CHARLES H. MAYO, M. D., ROCHESTER, MINNESOTA

THE large bowel is quite commonly affected with cancer, especially the cæcum, ascending colon, sigmoid, and rectum. While it is unfortunate that in the majority of cases of cancer of the large bowel the patients are late in receiving surgical treatment, it is fortunate that such a malignant process may remain for a long time a local one. The lymphatics in this structure, except in the lower rectum, are few as compared to those of the small intestine and other abdominal organs. The inflammatory and cicatricial zone which surrounds such areas of ulceration acts as an effective cofferdam. In fact, such inflammatory deposits often lead to early diagnosis of the true condition, and many cancers of the sigmoid and rectum considered hopeless at the time of a colostomy have within a short period become so much reduced that a radical extirpation has later been possible. Extirpation of the cæcum and ascending colon for cancer has given a high percentage of cures because an anastomosis of the ileum into the colon is an ideal enterostomy for delivering semiliquids. Malignant growths of portions of the large bowel other than the rectum are often extirpated and treated by immediate suture. As to the choice of a method of operation, each case must be considered individually. The Mikulicz method, a two-stage resection in the movable colon, is probably more commonly employed now than formerly except in cancer of the cæcum. This is one of the safest known methods, although the convalescence following is somewhat more protracted.

Cancers of the rectum in which not more than eight inches of bowel must be removed, the distal section being not nearer than two and one-half inches from the anal sphincter, are usually best removed through the Kraske sacral incision, with resection of the coccyx and part of the lower sacrum. In such operations the following procedures may be instituted: (1) A freely mobilized bowel projecting through the anus may, at times, be sutured outside; (2) a large tube may be sutured within the bowel with the terminus just within the anus; (3) a sacral anus may be made and the anal segment sacrificed; (4) a permanent colostomy may be made and the whole rectum removed at the same time or at a later period. A permanent colostomy, however, is quite abhorrent to all patients, and, if it is possible, they much prefer to have the intestinal delivery near its normal location even if uncontrolled, and at some additional risk from recurrence of the disease. The efforts to restore function in cancer of the rectum and to obtain good cosmetic results in external cancer have added much to the high percentage of recurrence. Permanent colostomy with total extirpation of the

[1] Read before the Southern Surgical and Gynecological Association, Atlanta, December 16-18, 1913.

rectum gives a higher percentage of cures than methods which restore function.

In patients suffering from cancer of the rectum in the region described we advise a colostomy, and through the incision made for this purpose the hand should be inserted and a general examination made of the abdomen, as well as the pelvis. If metastasis has occurred precluding cure or if impending obstruction demands it, a permanent colostomy is made. If there are no contra-indications because of metastases, a temporary colostomy is made with a sufficient spur to deflect all the fæcal flow through it.

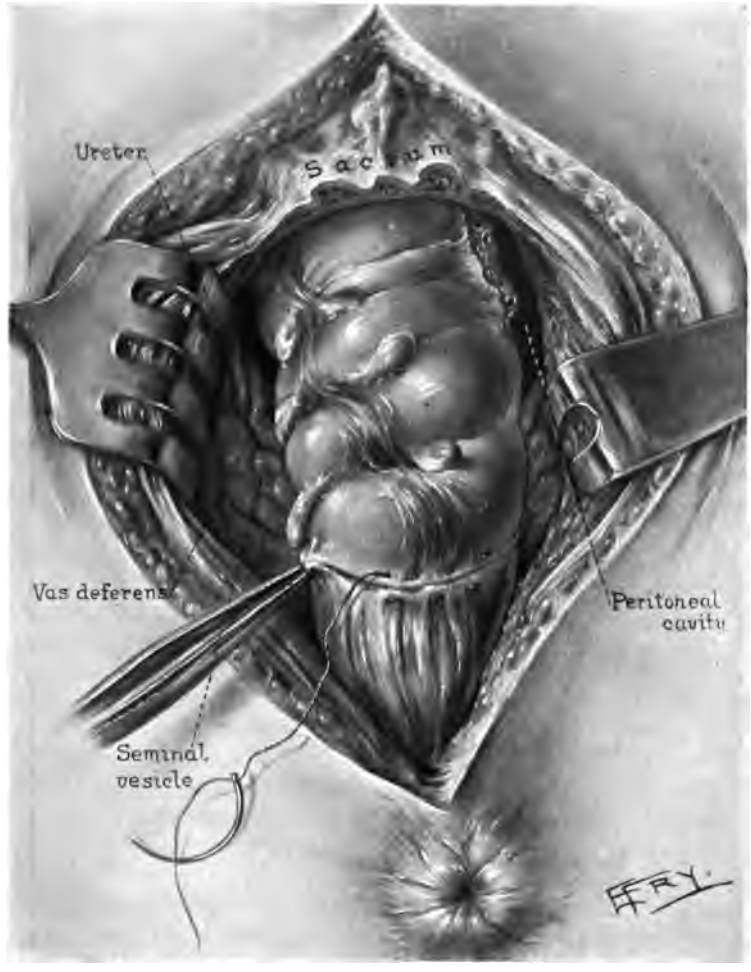
The upper sigmoid should be elevated so that the lower sigmoid need not be shortened so as to prevent the loosening of enough of it to bring together the anterior and posterior sections after the removal of the cancer-bearing area. A clear understanding should be had with these patients that, if the extent of the disease found at exploration precludes the possibility of resection with good union, and yet if total extirpation of the rectum should come within the limits of advisability with cure, a permanent colostomy is to be made with the preservation of all the colon possible. For this we employ a Gursuny twist through the rectus opening of the delivery portion, or the Littlewood type of colostomy through the lateral heavy oblique muscles. Both give exceedingly good control. In either case, at the end of twelve to fourteen days a total extirpation of the rectum is made through the Kraske route.

In the separation of the carcinomatous bowel from the surrounding tissues, great care is exercised to prevent opening it and contaminating the wound. After the pelvic peritoneum is opened the upper rectum and lower sigmoid can easily be drawn down to a great extent, and when sufficiently loosened the peritoneal opening is closed by re-attaching its parietal layer to the sigmoid at a higher level with catgut sutures.

Upon completion of the division of the intestine, cutting between two pairs of forceps applied above and below the growth, the slightly exposed surface of the bowel is cauterized by the hot iron to sterilize it and effectually scar the surface against grafting thereon any loose cancer cells that may be within the intestine.

While two and one-half inches of the terminal rectum is usually the limit of preservation with function of the sphincter, four inches is much more convenient in re-suturing the intestine. The lower segment is usually nearly twice the diameter of the upper or sigmoidal portion. About three-quarters of the circumference is surrounded by peritoneum. This smaller upper end of the bowel is now split on the surface anterior to its mesentery, the incision extending up the bowel for one and one-quarter inches, thereby adding two and one-half inches to its circumference. Upon cutting the sharp points from the divided edges the circumference becomes as great at this point as at the distal fragment. Since it is desirable to have the diameter of each end alike for a continuous suture, it may be advisable to make two shorter incisions on either side of the bowel. This extra size is demanded because the suture reduces the lumen by nearly one-half. While there is no peritoneum covering the lower segment of bowel at the point of suture, it is well known that a peritoneal surface is required only on one side for rapid healing.

To avoid fistula in the suture-line, which would usually occur at the free peritoneal or mesenteric side of the upper segment, the bowel is rotated one-half to bring the peritoneal surface posteriorly. This protects the mesenteric border. For the through-and-through suture, inverting the mucosa, chromic catgut is used and this is supported by sutures of fine silk which form a second row. At this stage two or three ounces of melted vaseline are poured over and into the cavity of the wound, especially the upper portion, where the parietal peritoneum has been closed. A few sutures bring the structures together loosely over the area of sutured bowel. A rubber tissue drain is inserted on either side of the intestine and brought out of the sacral incision. If the anus is not relaxed it is divulsed. If it shows any contraction upon examination it is well to divide the sphincter muscle anteriorly. This soon heals but permits thorough drainage temporarily from within the intestine. The rather large cavity




which is apparent during the process of the work is quickly filled by intra-abdominal pressure as soon as the position of the patient is changed from the operative one of abdominal recumbency — legs flexed at hips over the table. Without fæcal discharge there is very little danger of fistula; but should one occur, it is usually so tortuous that it closes itself. Colostomy incision can be closed, as a rule, two weeks after resection of bowel.

For the treatment of cancer higher up, there are several methods of extirpation with or without union, all depending on the extent and conditions in the individual case. When situated lower, the sphincter must, of course, be sacrificed.

SUMMARY

1. The method permits thorough abdominal exploration.

2. A primary or permanent colostomy should be made in most cases of this type.

3. Increasing the lumen of the anterior, and, if necessary, of the posterior portion of the bowel to double their diameter.

4. Rotation of the anterior peritoneal-covered bowel to secure the rapid healing posteriorly.

5. Stretching or division of the sphincter to secure drainage of the bowel.

6. Closure of colostomy to secure function.

7. If colostomy is permanent, remove rectum at second operation.

# CARCINOMA OF THE LOWER LIP; ITS DIAGNOSIS AND OPERATIVE TREATMENT

By JOSEPH C. BLOODGOOD, M. D., Baltimore

An investigation of carcinoma arising in any locality of the body should have for its object the determination of whether permanent cures have been accomplished, the per cent of these cures, and what were the causes of failure to cure. So far in this investigation I have determined that the two chief causes of failure to cure are late intervention, and, no matter what the stage of the intervention, incomplete surgery for that stage.

In investigating epithelial tumors of the lower lip I have for study about 200 cases, covering a period of about twenty-four years (1889-1913). The first question is, Have there been permanent cures after operation for cancer of the lip? This can be answered in the affirmative.

I shall consider first only the fully developed cancer of the lower lip. In these cases there is on the lip an ulcer or a fungus. The tumor has been removed with or without the glands of the neck, and the microscopic study has revealed a carcinoma of the spino- or cubocellular type. We have excluded, therefore, all benign lesions, all malignant warts (that is, lesions histologically malignant), and all rodent ulcers (the so-called basocellular epithelioma or rodent ulcer).

With very few exceptions we have preserved in the Surgical Pathological Laboratory of the Johns Hopkins Hospital the original sections, in many of the cases the original tissue, so most of the cases looked upon as cured have been restudied; and if the original diagnosis was not confirmed, they have not been included in this group. I believe that if the sections of these cases were referred to a number of pathologists there would be no disagreement from the diagnosis of carcinoma.

These cases, to repeat, were fully developed lesions of the lower lip — either ulcers or fungi, with the characteristic induration and surface appearance of the formerly so-called squamous-cell epithelioma or cancer.

These cases are first divided into two groups, primary and recurrent. In the primary group the lip lesion has not been subjected to any definite treatment, such as X-rays, radium, caustics, excision of a piece for diagnosis, cautery, or excision of the lesion.

Of course, in this primary group it is impossible to exclude some form of local irritation after the development of carcinoma. It is impossible to imagine a lesion on the lip which would not be irritated by the motion of the lip, biting by the teeth, and picking and scratching by the fingers of the host. In some of the primary cases undoubtedly some mild salves or caustics may have been used, but there has been no deliberate attempt at treatment.

In the second group the primary lesion on the lip had received some one or more forms of treatment mentioned above, there had been local recurrence, or recurrence in the glands of the neck only.

This is a very important division, because the differences in the results emphatically portray the danger of incomplete and unsuccessful treatment of the primary lesion of the lip.

The operations performed upon these primary and recurrent carcinomas of the lower lip have been of two types: In the first (our Group 1-a), the operation consisted of an excision of a V-shaped piece of the lower lip, including the lesion. In the second group, in addition to this, there was an operation on the glands of the neck, and this latter group is subdivided into cases in which the glands showed no evidence of metastasis under the microscope, and those in which there was no doubt as to the involvement of the glands. We have designated these groups *1-b, glands negative* and *1-b, glands positive.*

It is interesting and remarkable that permanent cures have been accomplished in every group, but the percentage of cures differs widely, and these figures give the key to the situation, and, in my opinion, absolutely settle the problem from a surgical standpoint.

The longest cured case in each group is as follows:

Excision of the lip only (1-a): Pathological No. 2535; living (1913) fourteen years after operation; the patient is now seventy-eight years of age. This patient was sixty-four years of age when he first noted a little ulcer on the lower lip, apparently due to the abrasion from a rough tooth. For three years the lesion remained a small ulcer with a scab which the patient occasionally picked, and during this time he had treated the lesion with some salves. It was impossible to estimate how long the carcinoma had been present. The gland operation was not performed. I wish to emphasize this case, because it illustrates that we have no way to estimate when we can accomplish a cure without the removal of the glands. In more recent years this patient would have been subjected to the routine radical excision of the glands of the neck.

This case must be looked upon as a cured cancer of the lower lip in which the operation consisted of the excision of a V-shaped piece of the lower lip, including the lesion and a narrow margin of healthy tissue. There was nothing in the gross appearance, the clinical history, or microscopic pathology to distinguish this cured case from others in this group who returned later with metastatic glands in the neck, or from cases which we have subjected to the combined local and gland operation, and found that the glands showed metastasis.

*Group 1-b, glands negative.* Here, in addition to the excision of the lesion on the lip, an operation was performed which had for its object the removal of the submental glands and submaxillary salivary and lymph-glands on one or both sides. I will discuss the details of this operation later.

In this group the microscopic study of the glands removed shows no evidence of carcinoma.

The patient who has lived longest since the operation is recorded under Pathological No. 1037. This patient is living (1913) eighteen years since operation. At the time of the operation he was forty-two years of age and had observed a blister on the lower lip about eighteen months. The patient often picked this blister. Up until three months before admission it remained the size of a pea, then it began to grow. When examined it was an ulcer 1 by 1.5 cm. in diameter with the characteristic indurated edge. In this case we may fairly conclude that the beginning of the clinically malignant growth was three and one-half months. Recently I have removed a number of such blisters within a few weeks after onset, and none have been microscopically carcinoma. In the case just mentioned there was no etiological factor such as smoking or chewing tobacco to explain the blister. It is one of the older histories, and in these the details as to the precancerous lesion are meager.

*Group 1-b, glands metastatic.* The patient Pathological No. 2091 is apparently perfectly well (1913) fifteen years after the operation, which consisted of the removal of the lesion on the lip and of all the glands beneath the jaw from parotid to parotid — subparotid, submaxillary, and submental. Studied microscopically, only the left submaxillary lymph-gland showed metastasis. The epithelioma occupied the left third of the lower lip and the angle of the mouth. The patient at the time of the operation was forty-four years of age; he was a constant pipe smoker and had first observed a wart on the mucocutaneous border of the left lower lip where the pipe rested. The wart was first observed four years ago, when it was the size of a split pea, one inch from the angle of the mouth. It grew slowly and finally developed into an ulcer. When he came under observation in the hospital, there was no evidence of the original warty growth, but the portion of the lip mentioned was occupied by an indurated ulcer.

These three cases illustrate the three groups of primary carcinoma of the lower lip.

Considering all cases in which five or more years have elapsed since operation, the probability or per cent of cures in the different groups has been as follows:

Group 1-a, 63 per cent; Group 1-b, glands negative, 95 per cent; Group 1-b, glands metastatic, 50 per cent.

In Group 1-a there are seven positive cures; three patients returned with metastatic glands in the neck; two of these were subjected to operation, but were not cured. In one instance the recurrence was local on the lip. These local recurrences will be discussed later.

Therefore, in ten cases of cancer of the lower lip subjected to a local operation only, three cases, or 30 per cent, returned later with metastatic glands in the neck.

In *Group 1-b, glands negative,* there are 21 cases. Twenty patients, or 95 per cent, are well five years or more since operation. The one failure was due to local recurrence in the lip.

These clinical results, in 21 cases in which our microscopic examination failed to find cancer metastasis, may be looked upon as

confirming the pathological diagnosis. This becomes obvious only when we consider the results in the next group:

*Group 1-b, glands metastatic.* Six cases are well five or more years since operation (50 per cent). In two there was a recurrence in the neck, but these patients were cured by secondary operations. In four cases the regionary recurrence was hopeless; two of these had local recurrence also.

These figures show that with the operation as performed only fifty per cent of the cases have remained free from recurrence in the neck when the glands removed at the first operation showed metastasis.

The accuracy of our figures and the clinical confirmation of our diagnosis as to the presence or absence of metastasis in the glands removed in Group 1-b is shown in the following, which are probably more than mere coincidence: The percentage of cures in Group 1-a, local operation only, is 63; that is, in 27 per cent the failure to cure was due to the presence of glandular metastasis at the time of the operation. Now when we put together Group 1-b, glands negative, 21 cases, and Group 1-b, glands metastatic, 12 cases, we find that the probability of metastasis at the time of operation is 37 per cent, which leaves 63 per cent with glands negative and equals the per cent of cures in the cases in which the glands were not removed. We, however, do not need this rather interesting coincidence of figures to indicate the necessity of the glandular operation. At least in the five-year cases the per cent of glandular involvement, either estimated by the microscopic examination of the glands removed in Groups 1-b or the recurrences in the glands in Group 1-a, is 37 per cent. Every patient, therefore, with a fully developed carcinoma of the lower lip of the spino- or cubocellular type runs the risk of metastasis. I have been unable, from a most critical investigation, to find any evidence from the clinical appearance, or the microscopic examination of the lesion on the lip, which would allow one to conclude whether the probability of metastasis is more or less. There is, therefore, every reason for routine removal of glands of the neck in carcinoma of the lip.

This, it seems to me, may be looked upon as a settled question. If the glands are involved, the probability of a cure from our present statistics is fifty per cent. I think I shall be able to show later that this can be increased by improvements in the neck operation.

However, this possibility and thirty-five per cent probabilty of metastasis to the lymph-glands of the neck after the cancer had ingrafted itself on the precancerous lesion, and the fact that when this metastasis had taken place the probability of a permanent cure is fifty per cent, justify the conclusion that the best time to excise the lip lesion is during the precancerous stage.

Judging from a tabulation of the duration of the disease from the onset of the first visible and palpable lesion to the time of operation and the duration of certain changes in this lesion which indicated at least the development of clinical carcinoma, we may conclude with a large degree of certainty that the removal of the lesion in the early weeks after its onset would accomplish a cure in almost one hundred per cent of the cases.

It is also my opinion that there will not be many unnecessary operations. Any lesion of the lower lip which does not heal within a few weeks should be excised. This can be done under local anæsthesia; the scar is insignificant, even to a woman.

### BENIGN PRECANCEROUS LESIONS OF THE LOWER LIP

Up to the present time (December, 1913), among about 200 lesions of the lower lip, 15 (about 7 per cent) have been microscopically benign. It is my opinion that these lesions represent, in gross and microscopic characteristics, the lesions that the remaining 185 patients told us about as the beginning of their trouble on the lower lip. But in the 185 patients certain changes had taken place which the patients themselves had observed and which we found when we studied the lesion in the gross and microscopically. Carcinoma, or malignant epithelioma, was present microscopically in every instance. In 18 cases the gross lesion was still what might be called a wart, but microscopically carcinoma was

Fig. 1. Pathological No. 12746. Precancerous lesion of lower lip: blister from smoking.

White male aged 33; first blister nine months; healing after ceasing smoking; recurrence six months after resuming, but did not heal when patient discontinued smoking again. Complete excision.

Serial sections show no carcinoma in excised area, but superficial ulceration with some atypical downgrowth.

Fig. 2. Pathological No. 14949. Photograph of excised piece from lower lip. The dark area is a smokers' burn.

White male aged 60; lesion one year. Complete local excision, November, 1913.

Microscopic section Fig. 5.

evident. I have called this lesion a *malignant wart.* In the remaining 167 cases the gross lesion was either an ulcer or a fungus, and microscopically a fully developed carcinoma, with few exceptions, of the spinal-cell type. I will discuss later the few cases of *carcinoma bascocellulare* or rodent ulcer.

It is interesting to note that nine of the benign lesions have come under observation in the last five years, while during the previous nineteen years there were observed only six benign lesions. This large increase in the number of the benign precancerous lesions of the lower lip is entirely due to the education of our medical students and to the members of the profession and public who have been reached by the local educational propaganda.

*Duration.* The duration of these benign lesions is of great importance, because it explains why we have accomplished cures in cancer of the lower lip in persons who have come for treatment many months or years after the beginning of the first visible and palpable change in a small spot at the mucocutaneous border of the lower lip. In these cases it is often impossible to estimate when cancer develops. One can be certain of two facts only, the duration of the disease and the presence of carcinoma. Now that I have had the opportunity to study critically fifteen benign lesions I can understand why some cures have been accomplished in cancer of the lower lip when the lesion has been present a considerable time.

In twelve of these fifteen benign lesions we have exact data as to their duration: two were present less than one month; one, two months; two, six to nine months; one, nine months to one year; one, eighteen months; two, two years; two, three years; two, five years.

Up to the present time I have never observed a lesion still microscopically benign with a duration of definite existence over five years. However, in some of the patients who have come under observation with cancer the history would suggest that the benign lesion in a few instances had been present and quiescent for more than five years; but, of course, one cannot prove this.

*Smokers' burn.* The most frequent benign precancerous lesion is a burn from smoking a pipe or cigar. At the mucocutaneous border of the lower lip (Fig. 1) there appears a small depressed area, dark in color and of leathery consistency. This dark area (Fig. 2) cannot be picked off as a scab. Microscopically it is composed of dried, hornified epithelium, beneath which there is a zone of epidermis in which the papillary body is practically absent; nor do we see sweat-glands or hair-follicles. In Figs. 3 and 4 we have the microscopic appearance of a burn of but four weeks' duration.

Fig. 3. Pathological No. 14116. Precancerous lesion: smokers' burn. White male aged 44; lesion four weeks. The section shows the mucous membrane at the edge of the burn and the new epithelium growing over the ulcer. See Fig. 6 for high power and Figs. 1 and 2 for the gross appearance of smokers' burn.

Fig. 4. Pathological No. 14116. High power of section shown in Fig. 5. New epithelium growing over superficial ulcer due to burn.

In Fig. 5 of a similar lesion of one year's duration (for gross appearance see Fig. 2) we note complete epidermization, while in Figs. 3 and 4, in which the lesion was of but four weeks' duration, there are still small areas of ulceration.

From this study I am impressed that in a smokers' burn of this kind, the epidermis of the mucocutaneous border is injured over a small area by a single or repeated application of heat. The probabilities are that the epidermal cells die, but do not become detached. This sequestrum of epidermis acts like a scab and new epithelium grows across. The dry, dead surface layer may remain intact, as in Figs. 2 and 5, for one year.

Patients who come to us with cancer tell us that the first change which they observe is that of a scab which can be pulled off. The scab stage is of various duration; then the patients observe that the scab has become larger; induration now appears with the formation of a definite fungus or ulcer. Microscopically this latter lesion is always carcinoma.

In some instances the excessive smoker experiences a burn with a blister. The blister heals and the lesion disappears, or in the position of the blister an ulcer (Fig. 6) or a wart appear with, later, the development of malignancy.

Patients who come under observation with benign smokers' burns, or with a cancer which has developed in one, often give a history of one or more such lesions which have appeared, healed and reappeared, usually at the same spot. This was the history in the case illustrated in Fig. 1.

Of the fifteen benign lesions, eight are distinctly smokers' burn; four are of the type illustrated in Figs. 1 and 2; two with the history of the development of a wart in a blister from a burn; two of a distinct ulcer (Fig. 6) after a smokers' burn. In seven cases there is no definite history of smoking, but the ulcer or wart developed in a fever blister in two cases and in wounds in five cases.

When the mucous membrane or epidermis of the skin is irritated or injured there re-

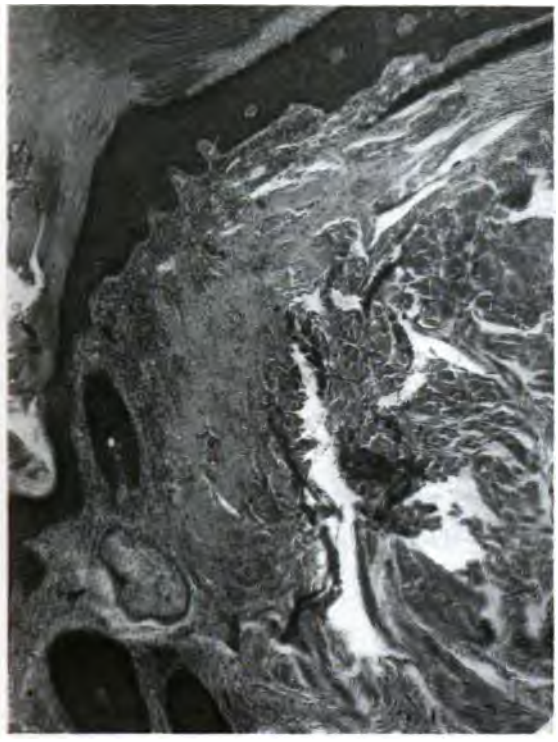


Fig. 5. Pathological No. 14949. Photomicrograph of smokers' burn of one year's duration, in which there has been no change.

The section shows a layer of epidermis without papillary-body formation, resting on chronic inflammatory tissue. See Fig. 2 for gross appearance.

sults either an ulcer or a hypertrophy of the epidermis. If the epidermis is entirely destroyed, there must first result an ulcer. If this remains unhealed, we have a chronic ulcer in which there is always an attempt at epidermization, or, in the healing of the ulcer, there may be overproduction of epithelium with the development of a wart, keratosis, corn, callosity, or papilloma, — all terms used to designate different gross types. These same lesions may develop at the point of injury without a primary ulceration.

So, in these fifteen benign lesions of the lower lip, there is always an etiological factor of some kind due to either a single or repeated irritation. When perfect healing does not take place there remains an epidermal defect of which the patient is conscious,, although there is no pain.

It is impossible to imagine a lesion on the

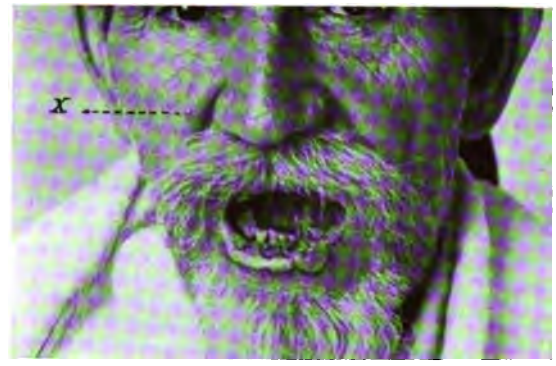



Fig. 6. Pathological No. 14492. Superficial ulceration of lower lip, associated with diffuse tobacco stomatitis and glossitis, of three weeks' duration; no induration. Wassermann negative.

Male aged 72, constant smoker; lesions completely healed after stopping smoking and mouth irrigation with bicarbonate of soda. If this lesion had not healed it would have been excised.

At *x* small subepidermal nodule, excised; microscopically benign basal-cell epithelioma.

mucocutaneous border of the lower lip which, after it has developed, does not continue to be irritated, either by the pipe or the cigar which the patient continues to use, or biting with the teeth, picking with the fingers, or even irritation with coarser forms of food.

In this study of 185 cases of cancer we have never observed a microscopically malignant lesion in which the patient has not told us of the first defect which, from the description, resembled one of the benign lesions which we have seen in the gross and under the microscope.

### DURATION OF LESION

Among our 200 cases of lesions of the lower lip, in only eleven was the defect observed three months or less. Three of these cases are benign; two very early malignant warts; two fully developed cancers, both in burns from smoking. In these two cases the removed glands showed no metastasis and the patients have remained well five years or more since operation. In one case there was a fully developed cancer in a lesion of three months' duration; the glands were not removed, and the patient returned in two years and eight months with metastasis to the glands. Then there are two recent cases of fully developed cancer of less than three

Fig. 7. Pathological No. 13926. Benign epithelial wart. Male aged 25; lower lip chapped and indented from biting with teeth; wart of three weeks' duration. Excision under cocaine. Remainder of lip healed after breaking the habit.

Fig. 8. Pathological No. 13926. Photomicrograph of benign wart. Wart of three weeks' duration, due to biting of chapped lips.

months' duration without metastasis to the glands, which up to the present time have remained well.

In this group of lesions of less than three months there is one case with metastasis to the glands of the neck. In a period of twenty-three years, with a record of 200 cases, this one case stands out unique in the fact that with a lesion of apparently only three weeks' duration the removed glands show metastasis.

Pathological No. 11036. This patient, a white male, aged fifty-five, has been an inveterate smoker of a pipe for years. He claims that his attention was called to the ulcer on the mucous membrane side of the lower lip only three weeks ago by pain. Pain is such an unusual symptom of onset that it is quite probable that the ulcer may have been there longer. The indurated ulcer was the size of a twenty-five-cent piece, began at the mucocutaneous border, and involved chiefly the mucous membrane side. This is an unusual position and as a rule the type of the tumor has been of the transitional or cuboidal cell. We have had four such cases, but this is the first one composed of spinal cells with pearly body formation. The operation in December, 1910, consisted of complete *en bloc* dissection of the glands on both sides of the neck, including the tips of both parotid glands, and a large V-shaped piece of the lower lip, including the ulcer, with a good margin of healthy tissue. This piece was dissected in continuity with the tissue of the neck. It was necessary to perform a slight plastic operation to repair the lip. The cancerous ulcer was entirely on the left side of the lower lip and only the left submaxillary lymph-glands showed metastasis. The other glands were negative. This patient is well and free from any signs of recurrence three years since operation (December, 1913).

This investigation of eleven cases of lesions of the lower lip in which the duration was three months or less demonstrates that carcinoma may develop even with metastasis to the glands within this period.

*Benign warts.* Fig. 7 illustrates a benign wart of three weeks' duration. Fig. 8 shows the microscopic appearance. This lesion developed in a lip irritated by habitual biting. The other defects of the lip due to biting are also shown in Fig. 7. After the excision of this wart the patient discontinued the habit, and now, December 1913, nine months since operation, the lip is entirely healed.

Fig. 9 illustrates a warty growth which developed in the wound of a razor cut, and this

Fig. 9. Pathological No. 11599. Benign precancerous lesion: wart on lower lip. Onset in cut from razor three years and three months ago. Local excision — no recurrence two and one-half years.

Fig. 10. Pathological No. 6458. Photograph of patient with extensive malignant wart of lower lip.

White male aged 62; onset two years; patient carries nails in mouth. Chief growth past two months. Local recurrence after incomplete operation. (See text.)

wart has been present three years and three months. The picture shows considerable down-growth of the papillary body, but at every point the basal cell is preserved, and there is no histological evidence of carcinoma. This patient is well two and one-half years since operation.

Of the fifteen benign precancerous lesions of the lower lip, twelve were treated by excision of a V-shaped piece of the lower lip (Fig. 2), and then, when the microscopic examination demonstrated no malignancy, nothing further was done. Among these twelve cases there was one recurrence — the case illustrated in Fig. 1. I saw this patient in consultation and advised the excision of the lesion with a good margin. Clinically, it was benign. The patient, a doctor, writes me that the microscopic examination showed no evidence of carcinoma. Apparently sufficient margin was not given to the smokers' burn; at least there was a recurrence within a few months. The lesion was re-excised. The microscopic examination of this tissue showed no carcinoma, and there has now been no recurrence six months since the last operation.

I am confident, from my own experience, that there should be no recurrence when the lesion is given a good margin, and this larger V-shaped piece will not leave a mutilating scar. Fig. 2 illustrated the proper margin.

In three of the cases a clinical diagnosis of cancer was made, and the operation consisted of the removal of the lip and glands of the neck. The operations were performed under ether narcosis, and one patient died of pneumonia — a white male, aged 61, who suffered with chronic emphysema of the lung.

*I emphasize this death*, because in lesions of the lower lip, especially in older people, or younger adults with some handicap, the complete operation under ether narcosis has a mortality; and, as I will discuss later, it is never necessary to give a general anæsthetic for the removal of the local lesion on the lip. This can be done under local anæsthesia. Then the tissue is examined carefully under

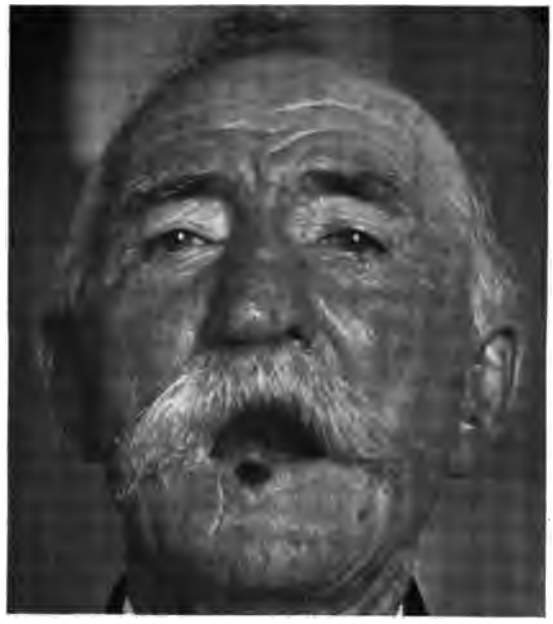


Fig. 11. Pathological No. 14394. Malignant wart of lower lip. Patient aged 43; wart eight months in wound from razor cut. Excision of lesion on lip only. Six months (1913) well. The scar to the right of the lesion is the result of the excision of a similar lesion thirteen years ago. This lesion was a malignant wart of eight weeks' duration having originated in a fever blister. At that operation the glands of the neck were removed, but did not show metastasis.

Fig. 12. Pathological No. 2826. Photomicrograph of a malignant wart of the lower lip.

White male aged 54; wart two months. No note on etiological factor. Excision of lesion and glands of neck. Glands show no metastasis. Patient well twelve and one-half years.

After microscopic study of the wart in this case there was no necessity for a gland operation.

the microscope. If this examination shows distinct benignity, there is, of course, no indication for the gland operation. If the lesion in the gross is a wart and the microscope shows early carcinoma, our experience also demonstrates that there is no necessity for the operation on the glands. When, however, the section pictures a fully developed carcinoma, the glands should be removed. As I will discuss later, this large and carefully investigated material demonstrates that the results are equally good with an operation in two stages, and that, except in the very extensive carcinoma of the lower lip, the removal of the local lesion and of the glands of the neck need not be done in continuity or *en bloc*.

*Malignant warts.* We have observed eighteen cases. The etiological factors have been the same as in the benign group — burn from smoking, a wound of some kind, a fever blister. The result of the injury, or the irritation, has been the development of a wart which has remained quiescent and has then begun to grow. Clinically, these malignant warts have been larger (Fig. 10) than the benign, and as a rule there has been ulceration at the surface and at the base. We have never observed a wart larger than the end of the index finger on the lower lip to be microscopically benign, but smaller warts (Fig. 11) have been microscopically malignant.

The duration of these warts from the time of the onset of the lesion to treatment has varied from two months to ten years. The shortest duration has been two months — two cases; one case, three to six months; three cases, six to nine months; two cases, nine months to one year; one case, eighteen months; two cases, two years; six cases, five to ten years. In all the cases in which the duration of the wart has been more than two

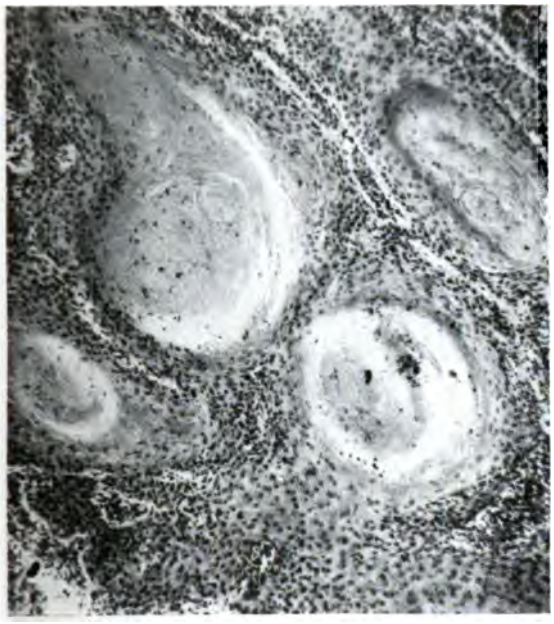


Fig. 13. Pathological No. 3994. Photomicrograph of malignant wart. The section shows the epithelial nests with pearly-body formations.

White male aged 61; pipe burn seven years; "scab" formation similar to that shown in Fig. 19 until six months ago, when a wart developed. Operation, November, 1901 — excision of lesion on lip and glands of the neck. No metastasis to glands.

The patient is well (1913) 12 years.

years the patients have observed recent growth, or slight ulceration, always of less than six months' duration. We have, therefore, no observation of a wart becoming malignant in less than two months, but we have observed warts that were apparently benign for nine years.

In five cases the operation consisted of excision of a V-shaped piece of the lower lip, giving the wart a good margin. In this group there have been no recurrences. In the remaining thirteen cases the operation consisted of the removal of the wart and of the glands of the neck at the same operation or in two stages. I have never been able to demonstrate metastasis in the glands removed. Fortunately, there have been no post-operative deaths after this apparently unnecessary glandular operation. There has been one recurrence, local, however, on the lip, and due, I am sure, to an incomplete local operation.

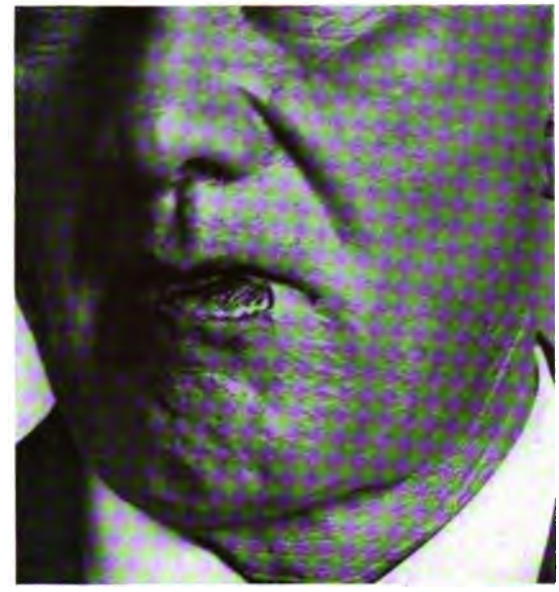


Fig. 14a. Pathological No. 14429. Carcinoma of the lower lip. Typical surface and indurated edge.

Male aged 50; lesion eight months; began in ulcer from carrying nails in mouth (carpenter).

Excision under cocaine. Microscopically, carcinoma spinocellulare.

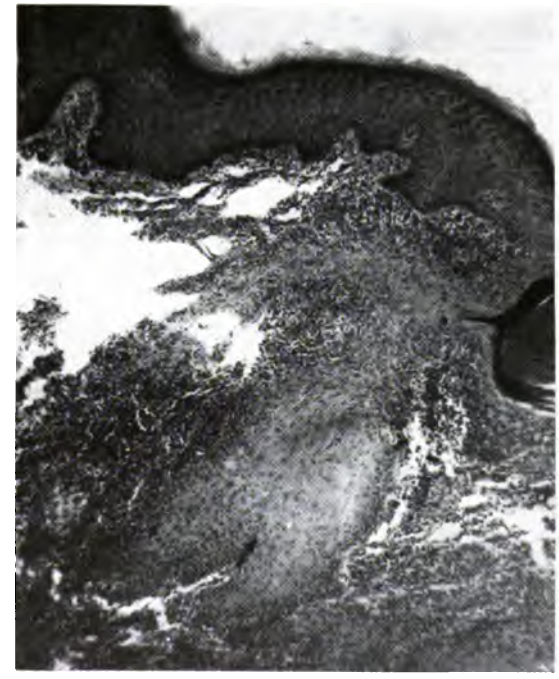


Fig. 14b. Pathological No. 14429. Carcinoma spinocellulare. See Fig. 14. Photomicrograph shows edge of newgrowth — typical, fully developed carcinoma.

Fig. 15. Pathological No. 15090. White male aged 51; unhealed wound after razor cut of 21 years' duration; for 9 years apparently there was nothing but a small scab or wart; for 12 years he has been treating the lesion with salf, recently with X-ray. The patient states that with every treatment the lesion grew larger. The excavated ulcer followed the application of the X-ray.

Pathological No. 6458 (Fig. 10). White male aged sixty-two. Onset of the wart two years in a small ulcer due to carrying nails in the mouth (patient is a shoemaker and does not smoke). The warty growth has gradually increased in size, especially during the last two months, and now involves almost the entire lower lip from angle to angle. The gross and microscopic study of the piece removed from the lip shows at the margin near the left angle apparently incomplete removal. The glands removed at the operation showed no metastasis. The recurrence in this case was prognosticated from the pathological study. The patient was readmitted two years later with a recurrence at the left angle, where it had been incompletely removed, and the recurrence involved the left cheek. An extensive local operation was performed. This patient died in March, 1913, six years after the second operation, with extensive local recurrence.

This case illustrates the danger of delay even in apparently innocent warty growths. It also shows the results of faulty surgery.

Fig. 16. Pathological No. 14593. White male aged 58; smokers' burn (pipe) 5 years; healing; recurrence 4 years; no local growth until 8 months ago; treatment with caustics 3 months. Now an excavated ulcer destroying the left two-thirds of the lower lip with extensive induration and infiltration of the left cheek and remains of the lower lip down to the jaw.

The photograph shows the result of local operation.

I shall discuss later the modification of the operation to meet the demands of the local growth.

In this group there has not been much difficulty in distinguishing the malignant wart, in which apparently it is not necessary to remove the glands. In the gross the lesion on the lip is a distinct wart (Figs. 10 and 11). Microscopically, the picture is chiefly that of papillary overgrowth (Figs. 12 and 13), but we always observe at the base of some of the hypertrophied papillæ the absence of the basal cell and the infiltration of the cuboidal and spinal cells into the lymphoid-cell stroma.

I should advise any surgeon, if he has any doubt about cases of this kind, to treat them as carcinoma fully developed and to remove the glands. It is my opinion, however, that the pathologically trained surgeon and the surgically trained pathologist should be able to recognize this early malignant group and save the patient the glandular operation, because

Fig. 17. Pathological No. 12637. Photograph of patient with inoperable cancer of the lower lip and glands of the neck.

White male aged 68. Patient a plasterer and carries nails in his mouth; onset wart three years; treatment with caustics and salf began 16 months ago with the result shown in photograph.

this operation, especially under ether narcosis, has an element of danger in the aged and handicapped younger individuals.

Fig. 18. Pathological No. 291. Photomicrograph of carcinoma spinocellulare in a small crack in the lower lip. Entire lesion shown in section. See text.

### CARCINOMA OF THE LOWER LIP

*Carcinoma spinocellulare.* In the attempt to decrease the number of deaths from cancer, there are two factors over which we have control — the duration of the disease and the treatment. To decrease the duration of the disease, we must educate the public and the profession on the potential dangers of the precancerous lesion. To improve treatment, we must educate the profession as to the danger of irritating applications to the precancerous and early cancerous lesion, the danger of excision of a piece for diagnosis, and incomplete removal of the local disease. From a more critical study of large groups of cases we must educate the surgeon as to the proper operation, which varies according to the situation, character, and duration of the lesion.

*Duration of the disease.* Among 200 lesions of the lower lip in 170 we have accurate data of the exact duration of the lesion on the lip. (The remaining cases are those sent to the laboratory from outside sources without exact clinical data, and in spite of much correspondence we have been unable to obtain these data.)

In only eleven cases (seven per cent) has the duration of the lesion been three months or less. I have discussed these cases. Within these three months it is possible for a cancer to develop, even with metastasis to the glands.

In an adult over twenty-five years of age, with a lesion of the lower lip localized at one spot, it will be safer, if this lesion does not heal within one month, to excise it. The danger of delay after one month is metastasis to the glands. After the proper radical local excision there should never be local recurrence, even in the fully developed carcinoma. But one cannot foretell when

Fig. 19. Pathological No. 9284. Photograph of excised piece of lip and mass of tissue removed from the neck, representing the complete en bloc dissection, from parotid to parotid.

White male aged 32; onset smokers' burn 4 years; local growth 6 months, more rapid after cauterization 4 months. The lesion is covered with a scab; it has the typical induration of cancer. The glands show no evidence of metastasis. This patient is free from recurrence (December, 1913) 5 years since operation.

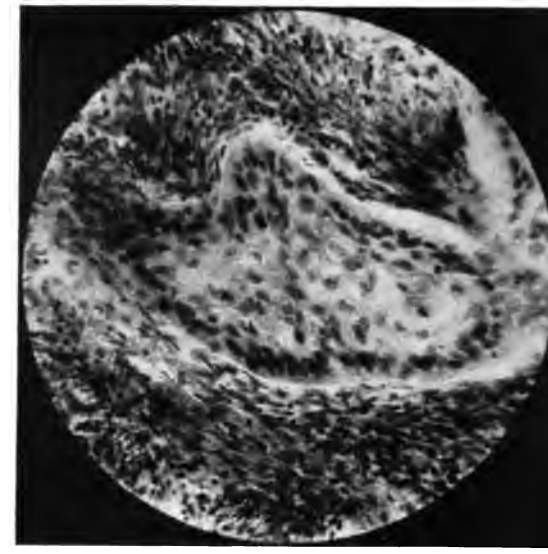


Fig. 20. Pathological No. 3614. Photomicrograph of metastatic area in submental gland removed 8 years after excision of a cancer of the lower lip. Well twenty years after first operation.

metastasis to the glands does take place. My investigation shows that in one lesion of only three weeks' duration glandular metastasis had already occurred. This, of course, is very unusual. The danger of metastasis to the glands of the neck is shown by our results in five-year cases: twelve cases with but six permanent cures, or 50 per cent. Undoubtedly better surgery will demonstrate that better results may be obtained by a more careful and radical dissection of the tissues in the neck, but I am confident the end-results will never be as good as when the operation is performed before metastasis has taken place. This is demonstrated in the investigation of 21 cases in which it is five years or more since the operation. This operation consisted of the removal of the lesion on the lip and of the glands of the neck. The microscopic examination of the glands showed no metastasis. Twenty (95 per cent) of these cases have been cured. The one failure to cure was due to a local recurrence on the lip. The lesion was an extensive one and incompletely removed.

We may, therefore, safely state that delay after one month means taking gamblers' chances, and the probability of metastasis to glands increases with further delay.

That the public and profession need education in regard to this is shown by the following figures:

TABLE OF DURATION OF THE DISEASE IN LESIONS OF THE LOWER LIP

| | |
|---|---|
| Less than 3 months | 11 |
| 3 to 6 months | 18 |
| 6 to 9 months | 17 |
| 9 months to 1 year | 17 |
| 1 year to 18 months | 21 |
| 18 months to 2 years | 7 |
| 2 to 3 years | 29 |
| 3 to 5 years | 18 |
| 5 years and over | 32 |

This table speaks for itself. I am quite confident that if the people and the profession understand the situation and the danger of delay the number of earlier cases in future years will be tremendously increased.

Among the ten cases in which the lesion was less than three months and in which five

years or more have elapsed since operation there has been but one failure to cure. In this case, already mentioned, the operation consisted of the removal of the lesion of the lip only, and this patient returned two years and eight months later with metastasis to glands and was not cured by a secondary operation.

This and many other observations demonstrate that no matter what the duration of the lesion on the lip and no matter how small it is, if the microscopic study shows a fully developed carcinoma of the squamous, or spinal-cell type, the radical operation on the glands of the neck should be performed.

Delay after three months, even up to five years or more, by no means indicates a hopeless condition. As has been stated before, the lesion may remain benign, it may only be an early malignant wart, or the development of cancer may be recent, or, for some reason, glandular metastasis has not taken place.

In spite of the most critical clinical and pathological investigation, I am unable to elucidate the factor or factors which induce the malignant epithelial growth in the local lesion, or which lead to involvement of the neighboring lymphatics. It does appear, however, that continuous irritation, either from smoking, or picking the lesion, or biting it, or any treatment which does not completely remove or destroy the cells in the local defect, increases the probability of malignant epithelial growth and of metastasis to the glands.

This is shown in the comparison of the results after similar operative treatment of lesions which have received no treatment and of those which have received treatment, but in which the treatment has failed to remove the local lesion (see Table).

In the fully developed carcinoma of the lower lip, excision of the lip only in primary cases has accomplished seven cures out of eleven cases, or 63 per cent, one local recurrence, and three metastases to glands. Of five recurrent lesions similarly treated, there has been but one cure (20 per cent); three local recurrences, all with metastasis to glands also; and one metastasis to glands without local recurrence.

In the group in which the operation consisted of excision of the lesion of the lip and glands of the neck, but in which the glands showed no metastasis, the results in primary cases are twenty cures among twenty-one cases (95 per cent). The one failure to cure was due to local recurrence. Of the five recurrent lesions treated in the same way there are three cures (60 per cent). The failure to cure in two cases was due to local recurrence.

In the next group the operation was identical, but the glands showed metastasis. Among the twelve primary cases there are six cures (50 per cent); of the six cases not cured, in all there was recurrence in the glands of the neck; in one case a local recurrence. Among five recurrent cases in this group there is but one cure (20 per cent). In all the four cases not cured there was both local and glandular recurrence.

This table demonstrates that any treatment which does not radically remove the local lesion on the lip decreases tremendously the possibility of a cure, even after the most radical surgical procedure. Among forty-four primary cases there are thirty-three (75 per cent) cures, with but three local recurrences, while among fifteen recurrent cases there are but five cures (33 per cent) and nine local recurrences.

It may be true that some of these bad results both in the primary and recurrent cases are due to faulty surgery, but I am confident that the chief factor is the duration of the lesion and previous irritating treatment.

This investigation also shows that incomplete excision with the knife makes the condition much more hopeless than incomplete eradication with strong caustics. The X-ray in one case has cured the local lesion, but the patient came under observation later with extensive involvement of the glands of the neck, and in spite of radical removal was not cured. In another case the apparent improvement of the local lesion under X-ray exposure led to a delay of one year, and then when the operation took place the glands of the neck were hopelessly involved.

To expose, therefore, a lesion of the lip to X-ray or radium, granting that it may ac-

complish a cure of the local lesion, subjects the patient to the danger of an operation for metastasis to the glands at a later period when enlargement of the glands brings the patient to operation. There is absolutely no way to recognize the beginnings of cancer in a lesion of the lip, except by a radical excision of the lesion and the microscopic study of the tissue excised. Then those patients who have cancer of the lower lip can be subjected to the operation of removal of the glands at the most favorable period.

I am confident that many conscientious and honest members of the profession have and may continue to treat apparently innocent lesions of the lower lip with X-ray and radium not knowing this great danger.

Among ten cases of cancer of the lip in which the local lesion was so extensive that it was necessary to resect a piece of the lower jaw, there has not been a single cure. The duration of the lesion in all these cases was more than nine months, in the majority more than two years. Every case was a recurrent one. Here we see exemplified the great danger of delay and incomplete surgery, in some cases in the most favorable period.

In nineteen cases the local lesion, or its metastasis to the glands of the neck, had reached such a stage that no operation was performed.

In this group the duration of the disease was one year or more. About one-third were recurrence cases.

Therefore, among 167 fully developed cancers of the lower lip, in 29 (17 per cent) the disease had become inoperable, due to delay of longer than nine months, combined in some cases with previous incomplete treatment of various kinds.

Figs. 14a and 14b (Pathological No. 14429) illustrate a fully developed carcinoma of the lower lip of eight months' duration, in which there had been no previous treatment. This lesion was excised radically under local anæsthesia and after the microscopic examination (Fig. 15, Pathological No. 14429) the glands of the neck were removed; metastases, however, were not found. It is my opinion that the prognosis in this case should be one hundred per cent. (Patient is well February, 1914,—six months.) However, had the glands in this case shown metastasis, the probability of a cure from our figures up to date would have been, at the worst, fifty per cent. I think, however, in a future communication I will be able to show that our better methods now established for the neck operation will increase the probabilities of a cure.

As I have stated before, we cannot determine from the duration of the local growth on the lip, or from its gross and microscopic appearance, whether the glands are involved or not. When the microscope shows carcinoma of the squamous or spinal-cell type, the glandular operation should be performed as if metastasis had taken place. If this is not done and the patient returns later with involvement of the glands of the neck, the probabilities of a cure are reduced from at least fifty to at most ten per cent.

My figures show that the probability of glandular involvement in primary cancer of the lower lip is thirty-six per cent, in recurrent carcinoma sixty per cent.

Fig. 15 (Pathological No. 15090) illustrates a recurrent carcinoma of the lower lip. Compare the excavated ulcer with the lesion in Fig. 14 and note the extensive infiltration beneath the skin over the chin. In this case there was a mass under the jaw and direct infiltration of carcinoma, which could be recognized with the naked eye, from the ulcer to the glands of the neck. This patient had had previous treatment over many years with caustics and X-ray.

Fig. 16 is a photograph of the patient after an operation for an extensive recurrent carcinoma of the lower lip. The excision was performed with the knife and the cautery. The patient refused a second operation for the removal of the glands of the neck.

Fig. 17 shows a carcinoma of the lower lip with involvement of the glands of the neck below the jaw which had extended beyond the possibility of radical removal. This is an example of an inoperable case.

One might ask the question, Can the lesion on the lower lip be so insignificant that it may be overlooked until the patient seeks advice for enlargement of the glands of the

neck? *This has occurred once in 200 cases.* Fig. 18 is a photomicrograph of the entire lesion. There is a small downgrowth of a hypertrophied papillary body; the basal cells are absent and the cuboidal and spinal cells are proliferating into the dense lymphoid-cell granulation tissue; some of the finer strands of these malignant epithelial cells are not clearly seen in this low-power photograph, but can be made out with a higher power. This patient came under observation in Halsted's clinic in 1893 with a mass beneath the left lower jaw. This had been present six months. Dr. Halsted completely excised all the tissue in the triangle beneath the left lower jaw. The tumor, on section, proved to be a carcinoma, the cells from the epidermis of the skin. We then carefully examined the lower lip and found a small crack at the mucocutaneous border to the left of the middle line. The patient was not aware of its existence. I excised this under cocaine. Eight months later the patient returned with a mass below the parotid between the sternocleidomastoid muscle and the internal jugular vein. This mass was radically excised with the muscle and the vein. Microscopically, a metastatic carcinoma similar to the first tumor removed from the neck was found. This patient was alive and free from recurrence five years after operation. In 1903 — ten years — a letter was returned marked "Dead." Further details we have been unable to ascertain.

This observation demonstrates that an occurrence of this kind is very unusual, but it also shows that even the most minute crack, with or without a scab, situated on the lower lip, should be radically excised, unless it completely disappears within a few weeks. Personally, I would excise a crack of this kind at once, because the lesion is so small that no one can tell how long it may have been present. I have never had the good fortune to observe such a crack, except in this case, but many patients with cancer have told me of these little cracks with a scab, which have remained quiescent for months before any local change.[1]

[1] Feb. 25, 1914. A second case has just been observed but it was immediately excised and the lesion proved to be still benign.

### TREATMENT OF THE PRECANCEROUS LESION OF THE LOWER LIP

The etiological factor should be sought for and immediately removed. The smoker must cease smoking, the individual who carries between his lips nails or other foreign irritating material should be instructed as to the danger and advised to discontinue the practice at once. The habit of biting the lower lip should be corrected, ragged or protruding teeth filed or extracted. Individuals who use tobacco in any form (the use of snuff should not be forgotten) should be advised to discontinue it at once and be given a mouth-wash of bicarbonate of soda (see Fig. 6).

The little lesion should receive no irritating treatment, not even the mildest caustics. If there is an ulcer, it can be washed with a solution of bicarbonate of soda and covered with a non-irritating ointment. An emulsion of bismuth in castor oil or a two per cent yellow oxide of mercury ointment has answered the purpose well in my experience. In extensive ulcerations, as shown in Fig. 6, and extensive fever blisters or chapping, I have had good results from covering the area with silver foil as employed by Halsted for dressing wounds. This silver foil is kept in place by covering it with a little cotton fixed with collodion. Such a dressing will usually hold twenty-four hours. It should accomplish its results in a few days.

If the lesion is small, its radical local excision is not at all mutilating, and it is my opinion that such lesions should be excised if they do not heal in a week or ten days. In the more extensive lesions, as shown in Fig. 6, one is justified in waiting longer. In my experience all these cases have yielded immediately to treatment. I can see no justification of any delay in smokers' burn and in the wart.

*The excision of the local lesion.* This should be done under local anæsthesia. The needle should pierce the skin at some distance from the lesion. Direct infiltration of the zone of disease itself is unnecessary and in carcinoma might be dangerous. To remove such lesions as shown in Figs. 2, 7, 11, and 14 is a very simple affair. To give them a good margin

never results in a mutilating scar. The part removed should be V-shaped (see Fig. 2) and should include the entire thickness of the lower lip, both skin and mucous membrane. In closing, first pass the suture threaded with a straight intestinal needle accurately through the mucocutaneous border. This keeps the red line of the lip in perfect approximation. Then the mucous-membrane stitches are passed and the skin is sutured. The wound can be dressed with silver foil and fixed with collodion or adhesive straps. The post-operative discomfort is practically *nil*, and the healing good when approximation is perfect.

When the lesion is near the angle of the mouth (fortunately, this is unusual in early cases), the technique of excision and suture is a little more delicate.

The chief point to remember is never to restrict the local excision of the V-shaped piece within dangerous limits. *If in doubt, take a little more.* The margin of healthy tissue necessary to excise in lesions of the lip is narrow as compared with a lesion of similar size and type on the tongue. The submucous and subcutaneous tissue of the lower lip resists the local growth of cancer to a remarkable degree, while on the tongue the mucous membrane rests on muscle which is least resistant.

As a matter of fact, I have never observed a local recurrence in the hands of experienced surgeons, except in very extensive primary and recurrent carcinoma. In such cases the complete excision means a plastic operation to restore the lower lip. Now, if the lesion is not very extensive (that is, one in which there might be a possibility of restoring the lip without a plastic operation, if the margin of healthy tissue were made a little narrower), the danger seems greater, and, as a matter of fact, our local recurrences have been in this group. When the lesions have been so extensive, as shown in Figs. 15 and 16, that restoration of the lip without a plastic operation was out of the question, the surgeon has experienced no subconscious influence to restrict the margin of uninvolved tissue, so that in spite of these extensive growths the local results have been better than in the previous group.

These extensive local operations are only necessary in delayed cases, usually those which have received incomplete treatment. This group, I trust, will grow smaller. In this group it is my rule now to cut the lesion out with the electric cautery, giving the palpable zone of induration at least 1 cm. of margin; then the burned area is cut out with the knife. No thought is given to the restoration of the lip until the local operation is finished.

The tissue excised at the local operation in the less extensive cases is studied microscopically, and if the disease proves to be a fully developed carcinoma, the gland operation is performed. Delay of a few days to a week in cases of this type has, as far as my experience goes, no element of danger.

In the more extensive cases, in which there is no doubt, clinically, as to carcinoma, the decision as to the operation upon the glands depends upon the local disease and the general condition of the patient. In these very extensive cases the excision of the local area and tissue in the neck should be in continuity or *en bloc*, but in some cases the extent of the local operation, in view of the general condition of the patient, is enough for one sitting. One then burns with the cautery the tissue passing from the local excised area into the neck, and at a later date performs the radical operation there.

*Operation upon the glands of the neck.* In the less extensive carcinoma of the lower lip the extent of the operation upon the glands varies with the position of the lesion. When the carcinoma involves or crosses the midline, one should remove the entire mass of tissue from parotid to parotid, as shown in Fig. 19. When the lesion is distinctly to the right or the left, one removes the submental area and the glands beneath the jaw on the involved side.

The dissection of the submental glands and of those beneath the parotid about the internal jugular vein seems to be most difficult. Our earlier cases show recurrences in both these areas, our later cases recurrences in the subparotid zone only. Now that we have extended the dissection to the subparotid zone by excising a piece of the parotid and

ligating and excising the upper portion of the internal jugular vein, the results are improving. Of course, in very advanced cases of glandular involvement the sternocleidomastoid muscle should also be removed. But these late cases seem almost hopeless, and as yet we have accomplished no cures.

Recently I have seen a patient operated upon by Dr. Guerry of Columbia, South Carolina. The neck operation was most extensive — the entire sternocleidomastoid and internal jugular vein were removed. The recurrence has taken place in the subparotid area up under the angle of the jaw. The local lesion on the lip in this case was a very extensive one at the left angle of the mouth, but there has been no recurrence here, nor in the submental or submaxillary zones.[1]

For the removal of the submental glands and those under one side of the jaw, one makes a curved incision, convex downwards, beginning below the lobe of the ear and extending to the jaw 1 cm. beyond the midline. This flap is dissected upwards, leaving the platysma muscle, until the base of this flap is freed to the lower border of the jaw. Then an oblique incision is made downward on the neck from about the center of the convexity; the outer and lower flap is dissected until its base corresponds to the middle of the sternocleidomastoid muscle. The inner and lower flap is dissected until the hyoid bone and fat over the submental area are exposed. Now one separates this subcutaneous mass from the lower jaw, isolating and ligating the facial vessels first. In making the separation from the region of the symphysis of the jaw I employ the cautery. Then one dissects this tissue from the masseter muscle down over the angle of the jaw until the tip of the parotid gland is exposed. Then the mass is dissected with a piece of the sternocleidomastoid muscle, exposing the internal jugular vein. Here one exposes and ligates the large facial vein. Now the mass has only one attachment to the tip of the parotid. The dissection extends along the base of the median lower flap, dividing the platysma muscle, the fascia of the deeper muscles, pushing everything up towards the submaxillary salivary gland. This tissue is quite vascular. Having separated this up to the region of the submental area, we now have a pretty movable mass. Next the internal jugular vein is exposed and ligated in the lower angle of the wound, divided between the ligatures, and lifted up with all the surrounding glands. The vein is again found beneath the mastoid process and again ligated. Then one cuts through the tip of the parotid gland. The only nerve divided in this dissection is a branch to the angle of the lower lip. This nerve cannot be saved without danger of leaving involved tissue. Now the mass is pulled downwards and to the medial side and all the tissue beneath the parotid and around the piece of the internal jugular vein is dissected free, exposing the digastric muscle. The submaxillary salivary gland is enucleated and its deep vascular attachments which pass through the muscles of the floor of the mouth are clamped and tied. The mass has now only an attachment to the submental area. In making the dissection here always take the fascia and some of the muscle. These submental glands lie between the bellies of the genio- and mylohyoid muscles, and can be easily left behind if one does not dissect fascia and some muscle.

The glands of the neck which may be involved in cancer of the lip are a small chain running perpendicularly from the symphysis of the jaw towards the hyoid bone between the muscles just named, a gland situated between the body of the lower jaw and the submaxillary salivary gland. This important gland will always be left behind if the salivary gland is not removed. Then there is a gland just below the submaxillary salivary gland, usually palpable in the neck of most adults. Then there is a chain of lymph-glands extending from the submental to this salivary lymph-gland, from this to the tip of the parotid and down behind the internal jugular.

An incomplete operation on the glands of the neck is really worse than no operation at all. To explore the neck to see if the glands are involved is a dangerous procedure.

In our six cured cases the glands of the neck were not extensively involved; in some

[1] This case is mentioned to show the difficulty of accomplishing a cure when these glands are extensively involved.

only the submental, in others only the submaxillary lymph-glands. As yet we have never accomplished a cure in the five-year group when the subparotid glands have shown metastasis. However, some of our recent cases with involvement of these glands, and in which the more extensive dissection was performed, are still free from any evidence of recurrence. Some of the six cases in which the glands showed metastasis, but in which we failed to cure, were not extensively involved. In one case the recurrence was in the submental area, apparently due to an incomplete dissection here, in all the others in the subparotid area.

Later, when our experience with the more recent cases has increased, there will be an opportunity for a second contribution on this subject. My opinion, however, is that the chief hope of increasing the number of cures in cancer of the lip lies in educating the public and the profession to earlier intervention, when the glands are less likely to be involved, and if involved are less extensively so.

If the glands of the neck are not removed at the primary operation, there may be an interval of many years, up to seven, before the metastatic area gives evidence of its presence by enlargement of the lymph-glands. Operation at this late stage should be done, but the chances of a cure are remote. We have accomplished one such cure. Fig. 20 is a photomicrograph of the metastatic gland. In this case the lesion on the lip was excised in 1893. It was a fully developed carcinoma. The patient returned eight years later with enlargement of the submental glands of eight months' duration; that is, there had been apparent freedom about seven years. This mass was most radically excised, and the patient is well (1913) twenty years after the first operation, twelve after the second.

Our experience shows that one should make the attempt at the radical removal of the lesion on the lip and glands of the neck at any stage of the disease whether the lesion is primary or recurrent. No necessary mutilation should be shunned. Every now and then one will accomplish cures in apparently desperate cases.

This, however, is surgery as a last resort, and such surgery would not be necessary if patients were educated to seek advice early and if the profession were trained to perform the proper operation in this early stage. In fact, we have the evidence here to show that lesions of the lower lip properly excised within one month from their onset should result in almost one hundred per cent of cures.

The failures to cure in this group of 200 cases are due not only to delay on part of the patient, but to bad treatment on part of the profession. These two evils can and should be corrected. It is really a very simple matter.

*Basal-cell carcinoma.* There are but five cases. In every case the lesion began in a defect of the epidermis below the mucocutaneous border of the lower lip. These tumors will be reported in the paper on *Cancer of the Face, Including the Chin.* They have not been considered here.

*Cubocellular carcinoma.* There are but four examples of this type. The lesion begins on the mucous-membrane side of the lower lip. The problems in diagnosis and treatment are identical with those in spinicellular carcinoma.

# THE OPERATION OF GASTROJEJUNOSTOMY AND THE PRINCIPLES WHICH SHOULD DETERMINE ITS USE[1]

By HERBERT J. PATERSON, M.C., F.R.C.S., London, England

THIRTY-TWO years have gone by since the operation of gastrojejunostomy was performed for the first time. The year 1881 was the birth year of gastric surgery. In the original operation the jejunum was united to the anterior wall of the stomach. Two years later Courvoisier suggested that the anastomosis should be made on the posterior gastric wall, a method advocated strongly by von Hacker in 1885. In 1901, Peterson pointed out the advantages of the posterior "no-loop" operation as practiced by Czerny. I would point out that the description "no-loop" is not strictly accurate. It is impracticable, indeed inadvisable, to make the anastomosis absolutely close to the duodenojejunal junction. It is more correct, therefore, to speak of the posterior "short-loop" operation. Many other minor modifications have been suggested, but none of them has become popular.

Gradually the anterior operation has fallen out of favor, chiefly owing to the teaching of American surgeons. To-day, with the great majority of surgeons the posterior "short-loop" operation is the method of choice, although a few surgeons, notably Rövsing of Copenhagen, Bastianelli of Rome, Bainbridge of New York and, I believe, Ochsner of Chicago, are still true to their first love.

From a perusal of current literature one might conclude that gastrojejunostomy is a panacea for all gastric ills and that failures are almost unknown. And yet, if we are honest with ourselves, we must admit that in some cases, few in number it is true, the end-results are unsatisfactory. Without doubt, during the past fifteen years there has been a great improvement in the results, both immediate and remote. Acute regurgitant vomiting is a thing of the past. But are our results as perfect as we could wish? Have we yet reached the ideal?

The improvement which has taken place is attributed largely to the adoption of the "short-loop" operation. I suggest we should ask ourselves whether there is a sure foundation for our belief in its superiority. How far is the improvement in our results due, not to the particular method employed, but to a general advance in our technique? At present we have little knowledge of the ultimate results of the anterior operation performed by modern technique. There are reasons why neither method is ideal.

It will, I think, be agreed that a gastrojejunostomy opening should be placed as close as possible to the normal outlet of the stomach — in other words, near to the pylorus. In the posterior "short-loop" operation this is an anatomical impossibility. On the other hand, the long loop of the anterior operation is undoubtedly a disadvantage. To put the matter succinctly, the posterior operation is good anatomically but physiologically unsound; the anterior operation is good physiologically but anatomically bad.

There is little doubt that the immediate results of the posterior operation are better than those of the anterior. The patients convalesce more smoothly and vomiting is less common, while after the anterior operation it may be necessary to wash out the stomach once or twice during the first few days. As to the remote results, I am inclined to think that the advantage rests with the anterior operation. After the posterior operation some patients (few in number, it is true), after remaining well for months or years, begin to suffer discomfort. In some instances this is due to a mechanical defect at the site of the anastomosis, such as a constriction produced by contraction of the mesocolon encircling the anastomosis. I am quite clear that the mesocolon should be sutured to the stomach a little distance away from the suture line, and not to the jejunum or to the suture line as is commonly taught. In other cases the defect is due to a kink produced by contraction of a

[1] Read before the Clinical Congress of Surgeons of North America, Chicago, November, 1913.

Towards the expenses of the researches embodied in this page, a grant was made by the Science Committee of the British Medical Association.

dilated stomach, to the formation of adhesions, or to rotation of the jejunum on its longitudinal axis during the process of suturing. Another cause of trouble is the narrowing of the lumen of the attached jejunum owing to the insertion of the serous suture too far from the cut edge. In some cases there is no obvious cause. It is true that some of these occurrences are preventable, but so long as we are merely human, they will be met with from time to time, and they do occur in the practice of the most skillful and experienced surgeons. The practical point is, after which method are they less common? Whatever the nature of the defect, it is a much more difficult matter to remedy it after a posterior than after an anterior operation.

It is said that the anterior operation is more often followed by jejunal ulcer, but I do not think there is any positive proof of this. The proportion of unsatisfactory cases is undoubtedly small — not more than 5 per cent; still such cases are met with, and the truth must be faced. It would be of great value if the members of the congress, many of whom have had much greater experience than has fallen to my lot, would investigate carefully their remote results. My own experience is that the results of the posterior operation are good, but those of the anterior operation slightly better. At present it would be premature to advocate a return to the anterior operation, but I do suggest that even received opinion may be but vanity, and that it behooves us from time to time to reconsider our methods in the light of the one true test, that of time. It is only by so doing that we may learn what to reject and what is worthy to survive.

Next I purpose to consider briefly what are the principles which should determine the use of gastrojejunostomy. The correct application of any surgical procedure depends on a proper appreciation of its effects. It is a truism that it is unscientific to perform any operation when the indications are not clear and the precise effect to be aimed at is uncertain. Therefore, from a clinical standpoint, it is important to answer the question, How does gastrojejunostomy act? Is the operation a mechanical one, or has it any physiological effect on the gastric secretion?

The prevailing view appears to be that the operation is a purely mechanical one — the provision of a new opening into the intestine, allowing the food to leave the stomach more readily and more quickly and, in the case of a duodenal ulcer, diverting the food from passing over the ulcer. For a good many years I have been advocating the view that the operation of gastrojejunostomy is a physiological one. It has been said, on the other hand, that the "physiological explanation of gastrojejunostomy is rot." I will endeavor to put before you very briefly the reasons for my belief.

First, in view of the allegation that gastrojejunostomy is a drainage operation, we must inquire what is the effect of gastrojejunostomy on the evacuation of the stomach. Diverse views have been expressed on this subject. My experience is that in cases in which there is no organic stenosis of the pylorus the evacuation of the stomach is slightly accelerated. Usually the stomach is empty in from three to four hours after a meal. Another means of comparing the motility of the stomach before and after operation is afforded by the study of the amounts recovered one hour after a test meal. In 60 per cent of a series of investigated cases the amount recovered after a test meal was less after operation than before, but the difference is not very great. In 66 cases the average amount recovered one hour after a test meal was 190 ccm. before operation and 180 ccm. after operation. As a rule, when there is organic pyloric stenosis the motility of the stomach is improved by gastrojejunostomy. I think, therefore, we may conclude that in those cases in which the gastric motility is impaired markedly by pyloric stenosis or by adhesions, the operation of gastrojejunostomy results usually in a marked improvement in the evacuation of the stomach contents. In those cases, on the other hand, in which, before operation, the motility is unimpaired, gastrojejunostomy usually hastens slightly, but occasionally retards, the evacuation of the stomach; but inasmuch as this retardation or acceleration falls within physiological limits, we are justified in saying that in cases in which, before operation, the motility of

the stomach is unimpaired, the evacuation of the stomach is unchanged by gastrojejunostomy. These observations seem to me to be fatal to the view that gastrojejunostomy is a mechanical operation. If gastrojejunostomy acts by draining the stomach, then unless the operation hastens markedly the evacuation of the stomach, it can be of no value. This is contrary to experience. We know that after gastrojejunostomy the evacuation of the stomach may be greatly delayed, and yet the patient gains complete relief and remains permanently well. It is not easy to imagine on what grounds a gastrojejunostomy is supposed to act as a drain. The stomach is not an inert bag, but a muscular organ, and we should not expect it to empty itself by gravity. There is evidence that after gastrojejunostomy the contractions of the stomach in some way control the effluent of gastric contents into the jejunum.

It is difficult by any mechanical explanation to account for the beneficial effects of gastrojejunostomy in the absence of pyloric stenosis. Take the case of gastrojejunostomy for duodenal ulcer. The view that a gastrojejunostomy acts by preventing the food from passing over the ulcer, is no longer tenable. We know from the evidence of radiography that in some cases the food continues to leave the stomach by the pylorus. If the mechanical explanation of the action of gastrojejunostomy be correct, such cases would not be benefited by the operation. This, I believe, is contrary to experience. If the mechanical explanation of gastrojejunostomy be correct, the pylorus should be occluded deliberately in every case when performing gastrojejunostomy. Some surgeons do this, but so far as I am aware, there is no evidence that warrants the conclusion that the results in cases in which the pylorus has been occluded are better than in those in which this has not been done. My view is that it is immaterial whether the food leaves the stomach by the pylorus or by the stoma.

Take the case of a gastric ulcer in the body of the stomach at the lesser curvature or near the cardia. How does the mechanical explanation of gastrojejunostomy explain the relief of pain in these cases? The anastomosis cannot prevent the contact of food with the ulcer, nor does it, as I have shown previously, invariably hasten the evacuation of the stomach. There are some who deny that a gastrojejunostomy is of any value in cases in which the ulcer is not near the pylorus. I hold a strong opinion to the contrary. I have performed a considerable number of gastrojejunostomies for ulcer of the body of the stomach and have followed up the after-results with great care, and in one case only has the result been unsatisfactory.

If then gastrojejunostomy does not act by drainage, how does it act? This suggests a second inquiry. Has gastrojejunostomy any effect on the gastric secretion which would account for its beneficial effects? The most striking effect of gastrojejunostomy on the gastric contents is the marked diminution of the total acidity. From examination of a large number of cases I find that the average diminution of the total acidity after gastrojejunostomy is 30 per cent. To what is this diminution of the total acidity due? It is due, I think, partly to diminution of the total chlorides secreted by the gastric mucosa and partly to neutralization of free hydrochloric acid by bile and pancreatic juice, which gain entrance to the stomach through the anastomotic opening. The presence of bile as demonstrated by Gmelin's reaction was detected in the gastric contents in 73 per cent of my patients after gastrojejunostomy. It is obvious that if bile gain an entrance into the stomach, pancreatic secretion must do so as well.

Notwithstanding the absence of Gmelin's reaction in 27 per cent of my cases, I believe that the presence of bile in the gastric contents is a constant and very important feature after gastrojejunostomy. My reason for this statement is the observation that in 99 per cent of my cases there is, after gastrojejunostomy, an increase of the mineral chlorides in the gastric juice. This increase is not due to greater activity of the gastric mucosa, because as a rule there is (in 75 per cent of my cases) a diminution of the total chlorides. If then this increase in the mineral chlorides be not the result of greater gastric activity, it must be due to chlorides added

from without to the gastric contents. I think, therefore, the inference is irresistible that the increase is due to the mineral chlorides of the bile and pancreatic juice, which gain entrance to the stomach through the anastomosis. If this hypothesis be correct, then the effect of undoing a gastrojejunostomy should be to diminish the amount of mineral chlorides in the gastric contents. This appears to be the case. On several occasions I have had an opportunity of performing gastric analyses on patients before and after gastrojejunostomy, and again after gastrojejunostomy had been undone. The result has always been the same — an increase in the mineral chlorides after gastrojejunostomy and a decrease toward the normal after restoration of the alimentary canal to its normal condition.

GASTRIC ANALYSIS—ILLUSTRATIVE CASE

| | |
|---|---|
| *Before gastrojejunostomy:* | |
| Total chlorides | 0.420 |
| Free HCl | 0.051 |
| Protein HCl | 0.289 |
| Mineral chlorides | 0.080 |
| *After gastrojejunostomy:* | |
| Total chlorides | 0.365 |
| Free HCl | 0.000 |
| Protein HCl | 0.153 |
| Mineral chlorides | 0.211 |
| *After gastrojejunostomy was undone:* | |
| Total chlorides | 0.343 |
| Free HCl | 0.018 |
| Protein HCl | 0.270 |
| Mineral chlorides | 0.055 |

Again, if my hypothesis be correct, in those cases in which, in addition to gastrojejunostomy, an entero-anastomosis is performed, we should not expect to find this increase, inasmuch as the bile and pancreatic juice are diverted through the entero-anastomotic opening. I have had an opportunity of investigating this point in three cases. In all of them there was, not an increase, but a decrease in the mineral chlorides.

GASTRIC ANALYSIS—ILLUSTRATIVE CASE

| | |
|---|---|
| *Before gastrojejunostomy:* | |
| Total chlorides | 0.335 |
| Free HCl | 0.003 |
| Protein HCl | 0.175 |
| Mineral chlorides | 0.156 |
| *After gastrojejunostomy and entero-anastomosis:* | |
| Total chlorides | 0.350 |
| Free HCl | 0.000 |
| Protein HCl | 0.226 |
| Mineral chlorides | 0.124 |

In this case, notwithstanding the exceptional increase in the total chlorides, there was a decrease in the mineral chlorides.

Again, if my hypothesis be correct, we should expect this increase in mineral chlorides to be more marked in those cases in which there is marked excess of bile in the gastric contents. This I believe to be the case, as is well illustrated in the following analysis:

GASTRIC ANALYSIS

Gastric Ulcer

| | |
|---|---|
| Total chlorides | 0.281 |
| Free HCl | 0.000 |
| Protein HCl | 0.131 |
| Mineral chlorides | 0.149 |
| *Six days after gastrojejunostomy:* | |
| Mineral chlorides | 0.365 |
| *Three weeks after gastrojejunostomy:* | |
| Mineral chlorides | 0.175 |

For some days after an anterior gastrojejunostomy there was marked excess of bile in the gastric contents and a high percentage of mineral chlorides. Gradually this excess of bile disappeared, and was accompanied by a corresponding decrease in the mineral chlorides.

The question may be asked, Does this increase in the mineral chlorides occur after operations other than gastrojejunostomy? For example, take the operation of appendicectomy: is there an increase in the mineral chlorides after this operation? In 26 per cent of my cases of appendicectomy there was a marked decrease, and in the remaining 74 per cent there was an increase; but whereas after gastrojejunostomy the increase in mineral chlorides is accompanied by a decrease in the total chlorides, after appendicectomy the increase in the mineral chlorides is accompanied, as a rule, by an increase in the total chlorides.

GASTRIC ANALYSIS

Appendicular Gastralgia

| | |
|---|---|
| Total acidity | 52 |
| Total chlorides | 0.250 |
| Free HCl | 0.000 |
| Protein HCl | 0.167 |
| Mineral chlorides | 0.083 |
| *After appendicectomy:* | |
| Total acidity | 72 |
| Total chlorides | 0.368 |
| Free HCl | 0.014 |
| Protein HCl | 0.270 |
| Mineral chlorides | 0.083 |

We see, then, that after a gastrojejunostomy there is a constant increase in the mineral chlorides of the gastric juice. This increase must be due to chlorides added to the gastric juice by the entrance of bile and pancreatic juice, because:

(1) The total chlorides of the gastric contents are diminished.

(2) Undoing gastrojejunostomy diminishes once more the amount of mineral chlorides.

(3) If an entero-anastomosis be performed, the increase in the mineral chlorides does not occur.

(4) In cases in which there is marked excess of bile in the gastric contents there is a marked excess of mineral chlorides.

(5) As a rule the increase in mineral chlorides does not follow operations other than gastrojejunostomy.

I find that the average increase in the mineral chlorides after gastrojejunostomy is 0.077 per cent. Doubtless part of this increase is due to neutralization of free hydrochloric acid and consequent formation of sodium chloride. This does not affect my argument, because:

(1) This neutralization must be caused by the carbonates of the bile and pancreatic juice.

(2) If, before gastrojejunostomy, free hydrochloric acid be absent from the gastric contents, there is still an increase in the mineral chlorides after gastrojejunostomy.

GASTRIC ANALYSIS

| | |
|---|---|
| *Duodenal ulcer before gastrojejunostomy:* | |
| Total chlorides | 0.259 |
| Free HCl | 0.000 |
| Protein HCl | 0.156 |
| Mineral chlorides | 0.102 |
| *Duodenal ulcer after gastrojejunostomy:* | |
| Total chlorides | 0.248 |
| Free HCl | 0.000 |
| Protein HCl | 0.054 |
| Mineral chlorides | 0.193 |

Roughly speaking, the bile and pancreatic juice contain 0.4 per cent of mineral chlorides. I think, therefore, we may conclude that on the average the gastric contents after gastrojejunostomy contain between 10 and 15 per cent of bile and pancreatic juice. The average amount of bile, therefore, which regurgitates into the stomach is between 5 and 10 per cent.

If my hypothesis as to the cause of the increase of mineral chlorides after gastrojejunostomy be correct, then we have at hand a means of comparing the effects of the different types of operation on the regurgitation of bile and pancreatic juice. The amount of the increase of mineral chlorides gives us an indication of the amounts of bile and pancreatic juice which regurgitate into the stomach. The average increase of mineral chlorides after the different types of gastrojejunostomy is shown in the following table:

| | |
|---|---|
| *Average Increase in Mineral Chlorides after Gastrojejunostomy:* | |
| Posterior (Mayo) | 0.082 |
| Posterior (isoperistaltic) | 0.096 |
| Posterior (vertical) | 0.087 |
| Anterior (transmesocolic) | 0.080 |
| Anterior (long-loop) | 0.070 |

The differences are small, and what there is is in favor of the anterior operation. The isoperistaltic posterior method is the least favorable. In those cases in which I have observed an excessive regurgitation, I have been conscious almost always that there was a slight twisting of the jejunum on its longitudinal axis and too great narrowing of its lumen. These observations seem to me to indicate that the type of operation is of less importance than the manner in which it is performed.

One may ask, how does a gastrojejunostomy act? Clearly, where there is pyloric stenosis the chief use of gastrojejunostomy is the provision of a new outlet for the gastric contents. This function of gastrojejunostomy does not require further discussion. It is with cases in which there is no organic stenosis that I am now dealing. I think it is clear that drainage does not explain the beneficial effects of gastrojejunostomy on ulcers. From a study of my cases it is evident that the relief afforded does not depend on hastened evacuation of the stomach. After gastrojejunostomy the evacuation of the stomach may be markedly retarded and the amount recovered after a test meal may be increased considerably, and yet the patient gains relief and remains permanently well. This is, I think, conclusive evidence against the mechanical hypothesis as to the action of gastrojejunostomy. The conclusion is irresistible that gastrojejunostomy is a physiological operation.

It is easy to ascertain the changes in the

gastric contents which follow gastrojejunostomy, but at present we must admit that we can only speculate as to which of those changes is the important factor in the relief of the patient. As I have already pointed out, a most striking feature after gastrojejunostomy is the diminution of the total acidity. As a rule, there is also a diminution of the active hydrochloric acid. Even if the active hydrochloric acid be not diminished after gastrojejunostomy, or be increased, there is still a diminution of the total acidity.

This suggests that it is the lowering of the total acidity which is of importance, rather than merely the diminution of the active hydrochloric acid. Possibly organic acids are of more importance than is supposed, and the diminution of the organic acids is one of the factors at work. That diminution of the free hydrochloric acid is not the chief factor is clear, since before operation free hydrochloric acid may be absent entirely, and yet the patient may gain relief from all symptoms. My impression is that in patients who have no free hydrochloric acid before operation the results are not so good as in those who have had free hydrochloric acid. Probably this is due to impairment of gastric digestion as the result of absence of free hydrochloric acid.

In cases in which there is severe chronic gastritis with abundant secretion of mucus, possibly a gastrojejunostomy opening acts as a less rigid sentinel than the pylorus, and so more readily permits the escape from the stomach of indigestible mucus.

Probably the lowering of the total acidity is but part of the aid which surgery gives to Nature. The presence of bile and pancreatic juice in the gastric contents after gastrojejunostomy is so constant that it is to the action of these juices I would give pride of place in the therapeutical effects of gastrojejunostomy. It would seem that they do something more than merely modify the acidity of the gastric contents. Haply they may produce an emulsion, or exercise some specific influence, as to the nature of which we are completely in the dark.

Lastly, as to the indications for gastrojejunostomy. In regard to the value of this operation in cases of pyloric stenosis, of duodenal ulcer, and of gastric ulcer near the pylorus, there is general agreement. It is its value in cases of ulcer of the body of the stomach and as a treatment for gastric hæmorrhage which is in doubt. If my hypothesis be correct, gastrojejunostomy is indicated in cases of ulcer of the stomach, even if they be not situated near the pylorus. As to hæmorrhage, I believe that in the majority of cases gastrojejunostomy is an efficient treatment, because my belief is that, as a rule, the hæmorrhage comes, not from the ulcer but from erosions of the gastric mucosa secondary either to hypersecretion or hyperacidity. Gastrojejunostomy removes both these conditions and so allows the erosions to heal. Gastrojejunostomy is contra-indicated absolutely when no organic lesion is present, except in cases of severe or continued gastric hæmorrhage. There are four practical lessons to be learned:

First, that the type of gastrojejunostomy employed is of less importance than the manner in which it is performed. Second, that occlusion of the pylorus is an unnecessary complication of gastrojejunostomy and is based on erroneous pathology. Third, that if gastrojejunostomy be a physiological operation, its use for the treatment of gastric hæmorrhage is correct and explicable. Fourth, that if gastrojejunostomy be a physiological operation, then it is as efficient a treatment for ulcers of the body of the stomach as for ulcers near the pylorus; in other words, gastrojejunostomy is preferable to excision.

I regard as "not proven" the view as to the great frequency with which carcinoma is grafted on simple ulcer. Granted, however, for the sake of argument, that it is proven; at any rate there is no evidence that such an event is frequent after a gastrojejunostomy has been performed. My own experience coincides with that of Professor Kocher and Dr. Gressot, that malignant degeneration of ulcers occurs in less than 3 per cent of all cases after the operation of gastrojejunostomy for supposed simple ulcer. Viewed from this standpoint, the teaching that excision of simple ulcers is advisable or necessary, is not based on established conclusions and is contrary to clinical experience.

# CHOLECYSTECTOMY VS. CHOLECYSTOSTOMY AND A METHOD OF OVERCOMING THE SPECIAL RISKS ATTENDING COMMON DUCT OPERATIONS

By GEORGE W. CRILE, M. D., Cleveland, Ohio

In reviewing the records of eight hundred and thirty-two operations on the biliary tract, performed at the Lakeside Hospital by my associates, Dr. Bunts, and Dr. Lower, and myself together with those performed by other surgeons at the Lakeside Hospital we find that cholecystostomy presents rather too frequently a history like the following: For a time the wound remains quiescent, then there is some fever and pain — the old familiar pain — associated with a sense of pressure and burning at the scar, which reddens, swells, becomes tender, raised, and after several days, by opening, allows the escape of mucopus, perhaps bile. Immediately the symptoms disappear and after a short period of drainage it closes. After an indefinite period this cycle repeats itself. It does not satisfy or content the victim of this cyclic gall-bladder to assure him that this is a safety valve, that no possible danger attends it, and that some day it may get well. He replies that he suffers keenly, that his work is broken into, that he is handicapped and wishes to be rid of the trouble. This means cholecystectomy, which uniformly gives relief.

Such cases present to us the following definite clinical problems;—Can it be determined at the time of operation whether a given case will eventuate in this malevolent cycle? Is cholecystectomy followed by any noxious after-effects? Will the mortality rate of cholecystectomy be greater than that of cholecystostomy in the cases that will be followed by the cycle of cholecystitis, eruption, quiescence? From the local conditions one can with considerable accuracy forecast the clinical behavior of the gall-bladder and the cystic duct. This prediction, however, is subject to modification on two principal accounts — the technique of the operation, and the after-care.

*Conditions which point to the cholecystitis obstruction cycle.* If the mucous membrane of the gall-bladder be gangrenous; if there be a stone embedded by ulceration in the cystic duct; if the wall of the gall-bladder be thickened by scar tissue as a reaction to infection, and if there be no bile in the gall-bladder, these conditions usually will be followed by recurrent obstruction and infection. On the other hand, if the gall-bladder have approximately normal walls, and if the cystic duct be approximately normal, then, no matter what the size or the number of stones, if the operation be performed with gentle manipulation so as to avoid any unnecessary trauma, there will be no post-operative pathologic cycle. Too much stress cannot be laid upon the necessity of gentle manipulations in the performance of the operation. What would happen to the urethra if a clumsy hand attempted to guide into the bladder a metal catheter or sound which had become corrugated by age and neglect? Or what would be the result of forcibly stuffing rough gauze into the urethra, so as to cause copious bleeding. The urethra would swell, become infected, obstructed, and later, perhaps, strictured. The base of the gall-bladder and of the cystic duct resent no less the bruising and wounding of their mucous membranes by gauze or by instruments. Following such needless injury there may be occlusion by strictures, for the normal cystic duct is very small and is easily closed by stricture. Finesse can accomplish a more certain exploration and a more difficult extraction than can rough manipulation.

*The comparative risk of cholecystectomy and cholecystostomy.* In the cases in which cholecystectomy is indicated the pathologic condition of the gall-bladder makes cholecystectomy safer than cholecystostomy, as the former obviates the necessity for prolonged drainage and limits the extent of infection, especially of infection of the incised wall. The mortality of cholecystectomy

depends also on the technique. The gall-bladder should be exposed by an ample wound so that there is free access to its base; the freeing and separation of tissue should be made by sharp dissection, care being taken not to cut into the liver, that bleeding and infection in that organ may be avoided. The entire gall-bladder should be freed from its attachment so that ample opportunity may be given for determining the exact place where the gall-bladder ends and the cystic duct begins, this being the point at which the division should be made. This technique causes but little reaction.

It is well to emphasize further the necessity of most careful determination of the exact point at which the division should be made between the gall-bladder and the cystic duct. If the division be made too high, so that a small part of the gall-bladder is left, there may result, as I have seen, the formation of a diminutive gall-bladder, with distinct cholecystitis, accompanied by pus formation and the formation of small stones. If, on the other hand, the cystic duct be divided so near its junction with the common-duct that the lumen of the latter is first narrowed by the pressure of the ligature, then totally occluded by swelling, this occlusion usually will be relieved by the subsidence of the swelling.

That there may be a correct division, therefore, it is essential to have ample room for work, and to maintain a clear field.

In cases showing chronic infection without febrile reaction the risk of cholecystectomy is less than that of cholecystostomy. On the other hand, in cases of acute cholecystitis with protective adhesions in which the cystic duct is obstructed, cholecystectomy will give a higher mortality than will mere drainage of the gall-bladder, for the reason that during the excision of the viscus, even with the most careful technique, it is necessary to traumatize the surrounding tissues to such an extent that the local immunity of the tissues is impaired. In such cases it is probably wiser to merely drain the gall-bladder, interfering with the local tissues as little as possible. Later, if necessary, the gall-bladder may be excised.

The clinical results of cholecystectomy in many cases of pathologic gall-bladder are clinically as much better than cholecystostomy as nephrectomy of a pus-riddled kidney is better than a nephrotomy. The convalescence after cholecystectomy is usually as uneventful as is convalescence after a salpingectomy for chronic suppuration. I have never seen any adverse clinical results following excision of the gall-bladder. It has been argued that the surgeon would be at a great disadvantage should there be later a necessity for operating for stone in the common-duct. To this objection one may reply that the common-duct occupies a fixed position with definite land-marks, and if a bloodless anatomical field be maintained by sharp dissection, the duct will be found easily, even though it be buried as deeply as possible under overlying adherent organs.

*Common-duct operations.* Operations for stone in the common-duct, however, even in the hands of the most experienced and expert operators, yield a high mortality rate as compared with operations on the gall-bladder, or with operations on the pelvic organs, for exophthalmic goiter, suppurative appendicitis, etc.

In the common-duct operation no vital organ is involved, but merely a duct. Death can rarely be attributed to the loss of bile or to infection of the peritoneum from bile, but is due to the gradual development of an asthenic state characterized by dullness of the mental and motor reactions, a dry tongue, partial suppression of bile, anorrhexia, and scanty urine, together with the impairment of the entire digestive system,—a progressive adynamic state which is extremely resistant to any known treatment. All common-duct cases by no means follow this course, but the severity of the post-operative symptoms is in proportion to the difficulty of the technique, which in turn depends upon the number of the stones and their impactions. My most impressive example of this mortal development was in the case of a fairly good risk patient whose entire common-duct and a large part of the hepatic duct were impacted solidly with sixty-five stones. The task of extracting these was not difficult and though

my patient went through the operation splendidly he died on the fifth day with the symptoms above mentioned. Neither infection, nor hæmorrhage, nor shock, nor ileus, nor pneumonia, nor urinary suppression were accountable. What, then, did cause death?

A clue to the real explanation of this hitherto baffling sequence of common-duct operations was found just at this time in the following facts established by certain experiments on the ductless glands which at the time of this patient's death were being carried out by me in conjunction with my laboratory associates, Drs. Austin, Sloan, and Hitchings. The liver performs its function in part through hormone action and in part through direct innervation. It is curious that for the performance of at least a part of its function the liver requires to have a simultaneous hormone and nerve stimulation. Now, the nerve supply of the liver is derived from the sympathetic system; the nerve fibers pass along the blood-vessels and the common-duct. As the process of evolution has thus abundantly sheltered these nerves against injury until the present surgical era, they have not evolved physical qualities for their protection as have the peripheral nerves. It is well-known that slight injuries will block the visceral nerves. It would appear, therefore, that in the course of common-duct operation for stone, performed by an operator who is unaware of this grave danger, the nerve supply to the liver will be more or less blocked traumatically. If the block be light and the patient have sufficient endurance, the temporary loss of liver function will be safely bridged; on the other hand, the more severe the trauma of the nerves, the more completely will the nerves be blocked and the longer will that block last. This conclusion corresponds quite precisely with our clinical facts. It gives an adequate explanation of the unexpected death of my patient, and makes it evident that surgery has been riding roughshod over a serious danger.

To obviate this danger so far as possible the following operation was planned: Gentle manipulations and sharp dissections are employed throughout, the whole operation being planned so as to subject the tissues to the least possible amount of trauma. A long, vertical, right rectus skin incision is made with an oblique incision at its upper end extending an inch or more across the upper abdomen, the skin along the line of incision having first been thoroughly infiltrated with novocaine. The muscular tissues are then thoroughly infiltrated with novocaine and the incisions carried down to the peritoneum. The peritoneum is anæsthetized and opened. By sharp dissection all adhesions are carefully divided, the dissection being rigorously carried along the white bloodless hairline between the peritoneum and the adhesion. No blood-vessel ever crosses this dead-white line. The whole line of dissection being bloodless, every tissue is accurately identified and no sponging is needed. The stones are laid bare by an ample incision through the duct-wall, and are picked out without injuring the duct-mucosa. The duct is then closed with fine chromic gut and a French needle, just as wounds of the intestine are closed; provided, of course, that bile drainage through the ampulla or the gall-bladder is assured. If drainage of the duct itself is not required, an iodoform drain is placed near but not against the line of sutures. The pre-incision infiltrations with novocaine prevent shock, while the sharp dissection and gentle manipulations cause the least possible damage to the important portal nerves and to an exceedingly vulnerable environment. So far as the operation alone is concerned, therefore, convalescence should be, and is, quiet and uneventful.

## CONCLUSIONS

From the evidence of our cases I draw the following conclusions:

1. Considering all the later consequences of infection, cholecystectomy in the type of cases indicated shows less morbidity than cholecystostomy. In these cases the clinical end-results of cholecystectomy are good, while in unsuitable cases cholecystostomy is followed by recurrent cholecystitis.

2. I have seen no adverse effects from cholecystectomy, provided that the division is made at the beginning of the cystic duct;

that no gall-bladder tissue is left; and that the division does not at all encroach on the common-duct. This technique can be readily carried out.

3. If acute infection be present, then in most cases cholecystostomy should be first performed, followed if required by a later cholecystectomy.

4. If the gall-bladder and the cystic duct be approximately normal, then the gall-bladder should be left, cholecystostomy being the operation of choice. If the gall-bladder be thick, contains much scar tissue, be shrunken, show chronic infection of the wall, be much impaired; if the cystic duct be partially or completely strictured; or if a stone be impacted in the duct, then cholecystectomy should be performed.

5. All gall-bladder operations, and especially common-duct operations, may be performed with a minimum of shock and discomfort by thorough nerve blocking with novocaine, by sharp dissection, and gentle manipulation.

6. The principal causes of the higher mortality in common-duct operations are the damage done to the nerve supply of the liver, and the loss of bile salts. The sharp knife dissection and the clean-cut, ample incision into the common-duct, with the consequent minimum nerve injury and minimum injury to the duct and its neighborhood, and in suitable cases the immediate closure of the common-duct by suture, will immensely improve the morbidity and the mortality following common-duct operations.

7. The mortality rate in the 832 records studied for the purposes of this paper was 7 4/5 per cent. This mortality rate, as well as the post-operative morbidity will be decreased by the application of the technical procedures described here.

---

# A BACTERIOLOGICAL STUDY OF FIFTY CASES OF NON-TUBERCULOUS DISEASES OF THE BLADDER AND KIDNEY[1]

By VERNON C. DAVID, M. D., Chicago
Instructor in Surgery, Rush Medical College

THE cases included in this study were chosen largely from the Surgical Service of the Presbyterian Hospital.

The work was prompted by a desire to make bacteriological as well as clinical diagnoses in cases presumably of infection. In a considerable number of the cases cystoscopy and catheterization of the ureters were done for diagnosis and to obtain urine from the renal pelvis. The urine from the bladder was always taken by catheter by the usual sterile technique. The urine was centrifuged in sterile tubes and the sediment examined microscopically. The smears were stained by the Gram method. A few drops of urinary sediment were spread on the surface of goat blood human ascites-agar in Petrie dishes, and plain agar slants were inoculated by progressive dilution of the urine depending on the number of organisms found in stained smears of the sediment. In this way isolated colonies were usually found on the third or fourth slant. In the same manner blood ascites-agar slants were inoculated for anaërobic growth by the pyrogallic acid-sodium hydrate method. After pure cultures of the various organisms obtained by these smears were isolated, subcultures were made on blood ascites-agar, plain agar, litmus milk, plain broth, gelatine, dextrose-agar and maltose, mannite, inuline, lactose and saccharose-media.

## *Clinical Material*

The cases studied were clinically classified as follows:

A — Chronic cystitis
- (*a*) Hypertrophied prostate
  - 1. Preoperative ..... 7
  - 2. Post-operative ..... 4
- (*b*) Catheter ..... 4
- (*c*) Cystitis cystica ..... 4
- (*d*) Stricture of urethra ..... 1
- (*e*) Prostatitis ..... 2

[1] From the Memorial Institute for Infectious Diseases.

| | |
|---|---|
| B — Pyelocystitis | 5 |
| C — Renal stone | 7 |
| (f) "Idiopathic" | 5 |
| D — Vesical stone | 2 |
| E — Tumor of bladder | 2 |
| F — Pyelitis | 2 |
| G — Pyuria (unclassified) | 1 |
| H — "Essential hæmaturia" | 1 |
| I — Ureteral stone | 1 |
| J — Perforating abscess | 1 |
| K — Pyelonephritis | 1 |

Of these patients 35 were male and 15 female.

In these 50 cases in which infections were suspected, growth was obtained from the urine in 44. No growth was obtained from four cases of renal stone, one case of cystitis cystica, and one of "essential hæmaturia."

*Organisms isolated.* From the 44 cases in which the urine gave growth, 73 organisms were obtained, of which 59 were aërobes and 14 anaërobes. The aërobes isolated were:

| | |
|---|---|
| Bacillus coli | 23 |
| Staphylococcus albus | 15 |
| Staphylococcus aureus | 3 |
| Bacillus enteritides | 5 |
| Bacillus alcaligenes fæcalis | 3 |
| Bacillus proteus | 2 |
| Bacillus pyocaneus | 2 |
| Streptococcus | 1 |
| Pseudodiphtheria bacillus | 1 |
| Unidentified gram-positive diplococcus | 1 |
| Pneumococcus | 1 |
| Influenza-like bacillus | 1 |

The anaërobes isolated were:

| | |
|---|---|
| Black pigment-producing bacillus | 4 |
| Gram-negative influenza-like bacillus | 4 |
| Staphylococcus parvulus | 2 |
| Gram-negative coccus | 1 |
| Bacillus funduliformis | 1 |
| Gram-positive staphylococci | 2 |

*Colon group.* Bacillus coli was isolated 23 times: in pure culture, 10 times, with staphylococcus 5 times, with pyocaneus twice, with gram-positive diplococcus once, with anaërobes 4 times, and with alcaligenes fæcalis once. All of the stains showed a marked variability in morphological and cultural characteristics. The shapes varied from long, thick bacilli to coccus-like forms which were difficult to identify as bacilli.

Three of the strains caused hæmolysis when grown on blood media, and in one case a hæmolytic and non-hæmolytic form were isolated, which in other cultural characteristics were identical. On agar a wide variance in the type of growth was observed. The most frequent type of colonies were large, white, opaque, and non-spreading, but semi-transparent amber colonies and a spreading amber growth were not infrequent.

Litmus milk was not uniformly altered, as only 6 strains coagulated it, whereas all acidified it quite promptly.

All but one stain fermented dextrose-agar, and 18 caused gas formation in it.

Lactose was fermented 23 times, and gas was formed 5 times.

Inuline was not fermented by any of the colon group.

Saccharose showed the most variation in regard to fermentation and gas formation, as only 11 stains fermented and 2 caused gas formation.

Most of the organisms were slightly motile, but a number were non-motile. The following table shows the chief cultural characteristics:

| | | | |
|---|---|---|---|
| Blood | | Mannite | |
| Hem. | 3 | Acid | 23 |
| Milk | | Gas | 5 |
| Acid | 23 | Saccharose | |
| Coag. | 6 | Acid | 11 |
| Dextrose | | Gas | 2 |
| Acid | 23 | Bouillon | |
| Gas | 18 | Cloudy | 23 |
| Lactose | | Inuline | |
| Acid | 23 | Alkaline | 23 |
| Gas | 6 | Gelatine | |
| | | Not lig. | 23 |

*Colon-like organisms.* From 8 cases gram-negative bacilli were isolated which resembled B. coli in motility and polymorphism, but which did not acidify milk nor, with the exception of one strain, coagulate it. Five of these organisms did not ferment lactose but had varying ability to ferment saccharose and mannite and always fermented dextrose without gas formation. Two stains were hæmolytic when grown on blood-agar.

Neumann and Lehmann [1] say that B. enteritides (Gärtner) is morphologically the same as B. coli, but while it has power to ferment other sugars it has lost ability to ferment milk sugar. By morphological and

[1] Lehmann and Neumann: Bacteriologische Diagnostik, 326–7.

pathological standards no constant differentiation between B. enteritides, B. typhosus murium and B. paratyphi is possible.

Three other organisms non-hæmolytic on blood were isolated, which not only failed to ferment milk sugar but which did not ferment mannite, saccharose, or dextrose. These correspond to B. alcaligenes fæcalis.

*Staphylococci.* Next in frequency to the colon group were the staphylococci, which were present in 15 cases. The staphylococcus aureus was isolated 3 times, but never in pure culture, while staphylococcus albus was present in 15 cases, 5 times in pure culture and 4 times associated with B. coli. In 5 cases staphylococcus albus, aureus, B. pyocaneus, B. enteritides, and the anaërobes were found in varying combinations.

The most striking characteristic of the staphylococci isolated was the lack of similarity of growth on different media. Practically no two strains isolated had the same fermentation reaction on sugars, and even the growth on milk, broth, and blood-agar was not uniform.

The following table will suffice to show the difference in cultural characteristics:

*Staphylococcus Albus*

| | | | |
|---|---|---|---|
| Blood | | Mannite | |
| H | 2 | F | 4 |
| NH | 13 | NF | 10 |
| Broth | | Inuline | |
| Clear | 5 | F | 0 |
| Cloudy | 9 | NF | 15 |
| Dextrose | | Saccharose | |
| F | 10 | F | 11 |
| NF | 5 | NF | 4 |
| Lactose | | Milk | |
| F | 8 | Al | 10 |
| NF | 6 | Ac | 4 |
| | | Coag | 1 |

*Staphylococcus Aureus*

| | | | |
|---|---|---|---|
| Blood | | Mannite | |
| H | 2 | F | 0 |
| NH | 1 | NF | 3 |
| Broth | | Inuline | |
| Clear | 1 | NF | 3 |
| Cloudy | 2 | Saccharose | |
| Dextrose | | F | 1 |
| F | 2 | NF | 1 |
| NF | 1 | Milk | |
| Lactose | | Al | 2 |
| F | 1 | Ac | 1 |
| NF | 2 | Coag | 0 |

*Other aërobes.* Of the other aërobes isolated, none were found in pure culture. B. pyocaneus occurred twice in chronic cystitis due to hypertrophied prostate, and both times with B. coli. One case of chronic cystitis had the unusual combination of pseudodiphtheria bacillus, streptococcus, and pneumococcus. A proteus-like bacillus occurred in two cases of pyelocystitis, and was gram-negative in both instances.

*Anaërobic organisms.* In 1898, Viellon and Zuber[1] studied by anaërobic cultures a number of cases of general character where gangrene or fetid pus was present, and described for the first time a number of organisms, both bacilli and cocci, which were present. In the succeeding few years Albarran and Cottet,[2] E. Rist,[3] M. Heyde,[4] Ghon,[5] Mucha,[5] and others described anaërobes occurring in peritonitis, appendicitis, lung abscess, brain abscess, pleurisy, osteomyelitis, otitis media, and cholecystitis, and demonstrated that anaërobes are not infrequently the only or prevailing organism found in some individual infections, but that they produce pathological lesions when injected into animals, the pathogenicity varying with the special anaërobe under consideration.

Of special interest to the subject at hand is the report of Albarran and Cottet of nearly 70 cases of infections of the urinary tract studied by both aërobic and anaërobic methods, although the great proportion of their cases were examples of extravesical infection.

In 25 cases of diffuse and circumscribed urinary infiltration, anaërobes were isolated 7 times in pure culture and 11 times in association with aërobes, such as B. coli, staphylococci, and proteus.

In 23 cases of periurethral abscess, anaërobes were isolated in all but 3 cases.

In these 48 cases, anaërobes were present in 86 per cent and were in pure culture in

[1] Viellon and Zuber: Recherches sur quelques microbes strictement anaërobes et leur rôle en pathologie. Arch. d. méd exper. et d'anat. path., 1898, ii, 347.

[2] Albarran and Cottet: Des infections urinaires anaërobes. XIII Congrès Internat., 1900, xi, 287. Le rôle des microbes anaërobes dans l'infection urinaire. La Presse méd., 1903, xi, 85. Jules Cottet: Note sur un micrococque strictement anaërobe trouvé dans les suppurations de l'appareil urinaire. Soc. de Biol., 1900, lii, 44.

[3] E. Rist: Anaërobe Bacteria. Zentralbl. f. Bacteriol., 1901, 30.

[4] M. Heyde: Beitr. z. klin. Chir., 1911, lxxvi, 1; Beitr. z. klin. Chir., 1910, lxviii, 642.

[5] Ghon and Mucha: Zur Frage über die Genese d'Appendicitis. Beitr. z. path. Anat., 1912, lii, 130. Beiträge zur Kenntniss der anaëroben Bacteria des Menschen. Zentralbl. f. Bacteriol., xxxix, 497.

33 per cent. The most common organisms found were micrococcus fœtidus and B. fragilis, each of which was found 4 times in pure culture. Others frequently isolated were B. funduliformis, diplococcus reniformis, staphylococcus parvulus, and B. nebulosus.

Albarran and Cottet also report the bacteriological study of 4 cases of cystitis and 10 of pyonephrosis.

Three of the cases of cystitis yielded an anaërobic organism, which was in pure culture in one instance. The same organism, diplococcus reniformis, was present in each case, and is the only anaërobic organism described in relation to cystitis found in literature.

The diplococcus reniformis resembles in shape the gonococcus, being but a trifle larger, and is not stained by the Gram method. It is an obligatory anaërobe and does not grow at room temperature. Small white colonies appear on dextrose-agar in 48 hours, but no gas is formed. Broth is cloudy in 24 hours and a precipitate is formed. Growth is accompanied by very fetid odor. Subcutaneous abscess is formed by injection into a guinea pig.

In 10 cases of the non-tuberculous pyonephrosis, the same authors found anaërobes (B. reniformis, B. fragilis, and B. ramosus) together in pure culture in one case, and in three other instances in association with aërobes.

With the exception of these 4 cases of cystitis and 10 cases of pyonephrosis, no other mention of anaërobic study of infections of the bladder and kidney was found in the literature.

In my 44 cases, anaërobes were isolated in 10 cases, 4 times in pure culture, and twice as the prevailing organism. In all 14 anaërobes were isolated, 11 of which were obligatory anaërobes. The organisms might be divided for convenience of description into black pigment-forming bacilli, fine influenza-like gram-negative bacilli, gram-negative cocci, and gram-positive staphylococci.

*Black pigment-forming bacilli.* These organisms occurred in four cases and were the prevailing form in one case. They are gram-negative, non-motile, and stain poorly. They grow only under anaërobic conditions, on blood ascites-agar slants; small moist white circumscribed colonies appear in 24 hours. Two or more colonies may coalesce to form a large one, but as a rule they remain discrete. Three of these bacilli did not hæmolyze blood and one did. On about the eighth to the twelfth day a brown pigmented spot occurs at the summit of the colony, and in 48 hours the whole colony is dark brown to coal black. The older the cultures, the blacker they become. A very offensive fetid odor accompanies the growth. In old cultures festoons of black growth and isolated black colonies appear in the depth of the blood-agar. The organism grows at room temperature, but best at 37° C. They are resistant, and cultures may be replanted after a month or more. The longer the artificial cultivation, the earlier the pigment appears, coming as early as the third to the fifth day. Subcultures on litmus milk, agar, broth, gelatine and sugar media such as mannite, dextrose, inuline, maltose, and saccharose, have all been unsuccessful. It has been difficult to obtain pure cultures of this black pigment-producing bacillus, and transplants on other than blood media have yielded other anaërobes, apparently growing in symbiosis, but which were not pigment producers.

The washed growth of three to six blood-agar slants, when injected intraperitoneally, subcutaneously, or intravenously, has produced no lesions in rabbits and guinea pigs. It must be added, however, that the material used had been under artificial cultivation for a number of months and may have lost its pathogenicity for animals. These organisms were isolated from a case of tumor of the bladder with a necrotic surface and accompanied by foul urine, from a case of recurrent vesical stone with foul urine, from the foul urine of a case of removal of the prostate, and from a case of chronic cystitis accompanied by slight stricture of the urethra. In all of these cases other organisms, such as B. coli, staphylococcus, or other aërobes, were present. In the urine of the tumor case, the black pigment-forming bacillus was the prevailing organism, though a hæmolytic

and non-hæmolytic colon bacillus and a gram-negative anaërobic coccus were also isolated.

It is probable that these black anaërobes are of rather common occurrence in putrefactive infections, as I have isolated them from ischiorectal abscesses and from the appendix, and Dick[1] has found them in several other lesions such as fetid abscess of the lung, chronic enteritis, from the throat, from blood and urine of scarlet fever cases, and from simple chronic tonsillitis.

Heyde[2] describes similar anaërobic bacilli (*schwartzen farbstoffbildender Bacillus*) in cultures from the appendix, but says they are curved, occasionally branched, appear in short chains, and live but a short time on artificial media. In these respects they differ from the bacilli just described, but in most other respects are similar. The inoculation of animals with this bacilli caused cachexia.

Rist[3] has described a spirillum nigrum producing black pigment which is unlike the above organism in every respect.

*Gram-negative fine bacilli.* In four cases, three of chronic cystitis and one of recurrent renal stone, a very fine non-motile gram-negative bacillus was isolated, in two cases in pure culture and in one other as the prevailing organism. In all instances the life of the organisms is very hard to maintain on artificial media, generally lasting only from two to three generations. It grows only at 37° C., and all attempts to grow it on any but blood-ascites media failed. It appears on blood-agar slants in 24 hours as an almost imperceptible cloudy growth without definite colonies, and is non-hæmolytic. Without great care it can easily be overlooked. It stains well, but is negative to Gram stain. Morphologically, the bacillus is very short and very fine and occurs singly. With the organisms from one case of chronic cystitis and prostatitis an attempt was made to produce cystitis in rabbits by injection of the washings from ten to twelve tubes, but failed. Injected into the renal pelvis through the kidney substance, the animals died in 24 hours and the organisms were isolated in pure cultures from the urine, in the bladder and pelvis of kidney, but not from the other kidney nor from the heart's blood. Autopsy in these animals revealed no macroscopic lesions of the bladder or kidney. The bacilli were grown in blood ascites broth (in large dishes) and autolysis was allowed to take place. The autolyzed bacilli and living bacilli were repeatedly injected into the bladder of guinea pigs, but no lesion was caused.

In two cases of chronic cystitis this fine bacillus was the only organism present. While numerous gram-negative anaërobic influenza-like bacilli have been described, all of these have been capable of cultivation of other media.

Davis[4] described a gram-negative bacillus which he isolated from the urine, which grew best under anaërobic conditions. It grew only on blood, hæmolyzed blood, and was non-pathogenic to animals.

*Bacillus funduliformis (J. Halle).* In one case of probable embolic pyelonephritis in which hæmaturia had been a prominent symptom, an obligatory anaërobe was isolated as the prevailing organism. This bacillus was negative to Gram stain, was non-motile, and grew only at 37° C.; it appeared on blood ascites-agar, lactose and dextrose-agar on the third to the sixth day. In pure culture, polymorphism was evident in the number of involution forms, manifested by different lengths of the bacilli, coccus-like fomes, beaded bacilli, and a general tendency for all of the bacilli to be slightly curved. The organisms generally appeared singly, but occasionally short chains were found. Only a very slight fetid odor was noticeable in cultures. The growth on blood ascites-agar was non-hæmolytic, and consisted of fine, plainly visible white colonies with no tendency to produce a spreading growth. On lactose and dextrose a growth was obtained, and a slight amount of gas was formed on dextrose. None of the sugars tested (dextrose, lactose, mannite, inuline, saccharose) was fermented. Milk was not coagulated nor acidified, inuline remained clear, and there was no growth in gelatine. A varying pathogenicity for laboratory animals is reported (Rist[1]).

[1] Dr. George Dick: Personal communication.
[2] Loc. cit.
[3] Loc. cit.
[4] D. J. Davis, J. Infect. Dis., 1910, vii, 599.

While in perhaps most instances anaërobic organisms are found in fetid exudates and often produce a fetid odor when grown on artificial media, the B. funduliformis has been found in exudates which were purulent but not foul-smelling; and in my case the urine, while bloody, was not ammoniacal.

*Gram-negative cocci.* Gram-negative cocci were present in three cases. In a case of vesical tumor, from which a black pigment-forming bacilli was isolated, an obligatory anaërobic gram-negative coccus was present, growing in symbiosis with it. This organism corresponds to no known anaërobic coccus, but as the group is undoubtedly large it will not be specially named in this article. It appears on media in 24 hours as white colonies which coalesce and by a spreading-growth cover the surface of the media. There is no hæmolysis on blood media; lactose, dextrose, and mannite are not fermented. The growth has a very fetid odor. On inuline and saccharose media there was no growth. Gelatine and litmus milk show a marked growth, but neither is changed. Morphologically this coccus is small, and occurs singly, in groups, or in short chains.

In two other cases obligatory anaërobic gram-negative staphylococci resembling staphylococcus parvulus were isolated. One of these cases was a chronic cystitis, and the other was a retroperitoneal abscess in which bladder irritation and hæmaturia were present.

These staphylococci, when stained, appear in small clusters of very fine cocci, which are barely discernible by oil-immersion lens. The best growth is obtained on blood ascites-agar, where it appears in 34 to 48 hours as dust-like colonies, resembling in indistinctness the growth of the gram-negative influenza-like bacilli already described. Hæmolysis on blood media fails. One strain caused slight gas formation on dextrose-agar, and there was some growth on lactose without fermentation, but growth on other media failed. The other strain grew only on blood ascites-agar. Fetid odor in growing cultures was absent.

Intramuscular injection of the washed growth from six tubes into a guinea pig caused no lesion, but in this instance also the organism had been under artificial cultivation for a long time.

While these two gram-negative staphylococci resemble staphylococcus parvulus (Viellon and Zuber) morphologically and to a great extent in cultural characteristics, they differ in causing no fetid odor on media and in absence of growth on broth.

*Gram-positive staphylococci.* In two cases, associated with other anaërobes, a few colonies of large gram-positive staphylococci were found, which were strictly anaërobic. They produced large white colonies on blood-agar but were non-hæmolytic and produced no green. Morphologically they could not be distinguished from the aërobic staphylococci.

## SUMMARY

1. Attention is called to the varying morphological and cultural characteristics of B. coli and allied organisms, and staphylococci found in infections of the bladder and kidney.

2. Anaërobic organisms were present in 20 per cent of the cases examined in which a growth was obtained, and occurred four times in pure culture.

3. Anaërobic organisms are described as follows: A very fine gram-negative bacillus growing only on blood media; a gram-negative pigment-producing bacillus, and associated with it a gram-negative coccus, corresponding to no known described type; funduliformis; staphylococcus parvulus; and gram-positive staphylococci.

[1] Rist. Loc. cit. J. Inject. Dis., 1909, vi, 224.

# TREATMENT OF TRANSPLANTABLE RAT SARCOMA BY FULGURATION [1]

By S. P. BEEBE, M. D., and ELEANOR VAN NESS VAN ALSTYNE, M. D., New York City

WITHIN the last five years de Keating-Hart [2] has published a number of papers in which he has advocated the use of fulguration as a complement to operation in the treatment of malignant growths. Following his lead, many surgeons, both abroad and in this country, have employed the method with varying degrees of success. By some it has been condemned as of very little or no value, while others believe it to be a decided advance in cancer treatment.

De Keating-Hart mentions that many of the failures have been due to the use of unsuitable apparatus and to its employment in cases in which the method is not applicable.

In order to form a basis for the use of the method in the treatment of human tumors and to get some explanations for the varying opinions in regard to it, the writers have carried out an extensive series of animal experiments, the results of which form the basis of this paper.

The apparatus employed in these experiments was purchased in Paris from Gaiffe, the maker who has supplied de Keating-Hart with his apparatus; and before it was shipped to this country it was carefully examined, tested, and approved by de Keating-Hart, and is similar in all respects to that employed by the originator of the method. For these reasons it appears that no exception may be taken to the results of our experiments which is founded upon the criticism that faulty or unsuitable apparatus was employed.

De Keating-Hart insists that the current must be of sufficient voltage to give a spark 8 cm. long. He is very insistent that the spark must be cold, so that the tissue changes which follow its application are not due to a cauterizing effect. The field of usefulness of this method of treatment is limited to localized growths without general metastasis. The tumor must be removed surgically as completely as possible, complete hæmostasis secured, and the whole field of the operation then subjected to the action of the spark. The purpose, obviously, is to kill off both the gross and microscopic fragments of malignant tissue which have not been surgically removed.

The manner of accomplishing such a result is not fully understood. De Keating-Hart maintains that it is not due to an actual killing of the tumor tissue by the spark, but to a change in the nutritional conditions of the region treated, so that the tumor cells are not able to grow. The bearing of our experiments on such a conclusion will appear later.

The plan of these experiments includes a study of the effect of the current on normal tissues — the physiological effects obtained when stimulation is made over what may be called critical areas, such as the course of the large nerve trunks and the heart. Likewise a study has been made of the effects upon transplantable sarcoma of rats. It is these latter studies which make up the major portion of these experiments.

1. *The effect of the current on normal tissue.* The chest of several guinea pigs was shaved, and the pigs were anæsthetized and exposed to the high-frequency spark directly over the cardiac area for varying lengths of time, from 30 seconds to two minutes. The length of the spark varied from 8–12 cm. The animals suffered no serious damage or shock from this experience, and recovered from the anæsthetic with very little disturbing effect. In these preliminary tests, it must be remembered, the current was applied to the intact skin of the chest wall. A further series of animals was fulgurated over the neck region along the course of the vagus, the skin being intact. No disturbing effects whatsoever were observed. It seemed to us that the current was diffused by the other tissues to such a degree that the heart was not influenced to any appreciable extent.

The next experiments were made upon dogs under ether anæsthesia. The carotid artery, internal jugular vein, and vagus nerve were exposed without, however, dissecting them

[2] La fulguration et ses resultats dans le traitement du cancer. 2me. edition. Paris, 1909, A. Moloine, Editeur.

[1] From the Huntington Fund for Cancer Research, Loomis Laboratory, Cornell University Medical College, New York.

free from their common sheath. Sparks applied along the course of the vessels caused practically no disturbance to the heart. The vagus was next dissected free and supported on two glass rods away from the other tissues. An 8-cm. spark was applied directly to the nerve for a period of 30 seconds. There was an immediate change in the respiration. There were very rapid respiratory movements; the heart continued to beat but was quite irregular. The nerve was then returned to its sheath and the wound closed. The animal recovered from the experiment promptly and appeared to suffer no permanent ill effects. Another animal, on which a similar experiment was made on both vagi at the same time, suffered extreme prostration, recovered very slowly, and died the next day. It seems evident that to cause any serious damage to the vagus it is necessary to apply the current directly to the nerve trunk. If the nerve is protected by the great vessels or the nerve sheath, the current is diverted to such an extent that practically no damage is done.

2. *Nature of the local reaction following fulguration.* The high-frequency spark produced by this apparatus is called a cold spark, because it does not immediately cauterize the tissue. The question arises as to how the effect is produced, if there is no local destruction of tissue. De Keating-Hart[1] is inclined to explain the effect as being due to some subtle physiological change which is not accompanied by marked anatomical alteration:

"La plupart ont crû voir dans la fulguration un moyen de destruction directe du cancer. Moi-même, au début, j'avais attaché à la sidération de la cellule cancéreuse par l'étincelle une importance que j'ai, depuis, reconnue illusoire. Or, les recherches histologiques nous ont montré que la *destruction*, quand elle existait, était superficielle. D'où il semblait naturel de conclure que la vertu curatrice de l'étincelle était à peu près nulle et que le seul effect qu'on dût attendre d'elle était de hâter la cicatrisation des plaies cancéreuses, enserrant ainsi l'élément pathologique dans les mailles d'un tissu fibreux défensif.

"Or, rien de ces deux effets, *destructeur* et *sclérogène*, ne me paraît suffisant à expliquer ce que nous observons. Je dirai plus: ni l'action cicatrisante, ni le pouvoir destructeur ne me semblent contribuer à la cure du cancer, *la première n'existant pas, le second ne devant pas être recherché* dans la plupart des cas.

"Examinons d'abord le second: le chirurgien a enlevé avant l'étincelage tout ce qu'il était possible de séparer, sans danger excessif, de l'être vivant. Les organes qui restent, s'ils ont droit au respect du bistouri, ne doivent pas attendre moins de l'étincelle, et celle-ci n'aura que de rares occasions de parachever l'œuvre chirurgicale; sauf en quelques cas exceptionnels donc, il sera inutile de produire une escarrification électrique.

"Quant à *l'action cicatrisante*, des apparences trompeuses y ont fait croire; mais l'expérience m'a conduit peu à peu à des conclusions contraires. Certes, de larges pertes de substance ont été sous nos yeux, après fulguration, rapidement comblées; mais si nous examinons de près le mécanisme de ces fermetures, nous pouvons constater qu'elles sont dues non tant à une reformation cellulaire intense qu'à un énergique appel centripète des tissus mous environnants. Quand ceux-ci s'y prêtent, les téguments sont rapprochés bord à bord et la cicatrice se fait assez vite avec un aspect *linéaire* qui dès les premières observations lui a valu le nom très juste d'autoplastie naturelle. Mais si, en revanche, la peau trop tendue ne peut couvrir la plaie, celle-ci, loin de continuer à se fermer, demeure, souvent des mois entiers, sans tendance à la cicatrisation, véritable ulcération saine mais *torpide*.

"De même, si l'on traite des *ulcères variqueux* à l'aide d'étincelles de haute tension à *dose et à puissance fulgurante*, on supprime leur aspect malsain, mais *on ne hâte pas leur cicatrisation;* loin de là, bien souvent je l'ai vue notablement retardée.

"Ni *cicatrisante*, ni *destructive*, comment donc expliquer l'action curative de l'étincelle sur le cancer?

"Nous en sommes encore en ce point réduit aux hypothèses. Sans entrer dans le détail des recherches que j'ai entreprises à ce sujet, je dirai simplement ici la façon dont je conçois les effets de la fulguration sur les tissus.

"L'étincelle de *haute tension à dose fulgurante* produirait sur ceux-ci *des effets d'ordre surtout physiologique*, sans altération anatomique marquée. Nous savons déjà que la foudre, les courants industriels puissants peuvent déterminer des paralysies temporaries *sine materia*, des troubles sensitifs ou psychiques, où le microscope non plus que la recherche des réactions de dégénérescence ne révèlent quoi que ce soit d'anormal. De même, l'étincelle de haute tension, projetée sur une peau saine, produit momentanément des vasoconstrictions intenses, et, frappant le muscle sterno-cléido-mastoïdien ou le tendon d'Achille, un torticollis ou un équinisme pouvant durer plusieurs semaines et davantage. Que ce soit par une action spasmodique secondaire sur les vaisseaux, or pour toute autre cause, la fulguration produit aussi, nous l'avons dit une sorte de stupéfaction locale[1] retardant la cicatrisation, c'est-à-dire la pullulation de la cellule épithéliale saine au point frappé. N'est-il pas ad-

[1] Sidération sous-cancéreuse modifiant la nutrition du tissu et secondairement celle du cancer.

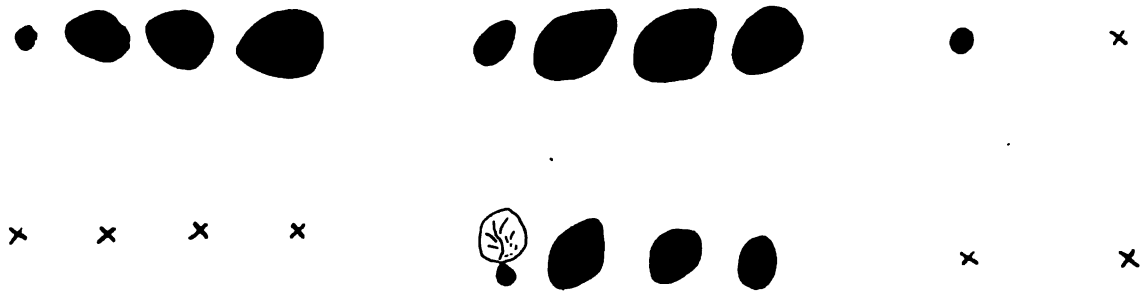


CHART 1

The chart gives in the shaded areas the comparative size of the tumors in the two areas. Careful measurements were made of the tumors with fine calipers every ten days, the first measurement being made ten days after the tumors were planted. The tumors in the upper line are those in the control area between the shoulders, the lower line those in the experimental area which had, before planting, been subjected to fulguration. In this chart are plotted the results obtained from three different animals, which are representative of the results obtained by treating a large number of animals. In the first animal no growth was obtained in the experimental area, while in the control area it grew well, showing that the animal was not immune. This animal is typical of a large number treated in the same fashion. In the second animal the plant was made just outside the experimental area, and the result shows positive growth, indicating that the inhibiting effect is confined strictly to the area of reaction following the spark. The third animal is typical of a small number of animals which showed no growth in the experimental area but in which the growth in the control area, although positive, quickly regressed.

In such animals we are either dealing with animals whose natural immunity is high, or their immunity has been increased by absorption of the graft planted in the experimental area.

missible que cette même action s'exerce avec une force plus grande encore, sur la pallulation néoplasique? Cela expliquerait les effets d'arrêt évolutif constatés souvent ainsi, non seulement sue la plaie opératoire mais autour d'elle, en des régions plus ou moins infiltrées de cancer où le bistouri n'est pas intervenu, mais assez superficielles pour avoir perçu le choc de l'étincelle promenée autour de la perte de substance."

In order to determine to what degree normal tissues are affected we fulgurated a number of guinea pigs on the abdominal wall over an area as large as a silver half-dollar for a period of 30 seconds to one minute, having a spark always at least 8 cm. in length. These pigs were killed at intervals of from one day up to six days after fulguration. The experimental area of the abdominal wall was removed and fixed in Müller's fluid for histological sectioning.

### HISTOLOGICAL CHANGES [1]

*Twenty-four hours.* There is extensive œdema of derma and subcutis, intense congestion of vessels, small hæmorrhages, and considerable exudation of polynuclear leucocytes. The subcutaneous muscle fibers are extensively vacuolated. The epidermis shows desquamation of cells.

*Forty-eight hours.* There is still much œdema and exudate. In the muscular layer there is beginning proliferation of endothelial cells of capillaries and of nuclei of the sarcolemma cells. In the epidermis there are small collections of leucocytes.

*Seventy-two hours.* The œdema of the derma and subdermal tissues is moderate. There is intense congestion of vessels and some extravasated blood. There are a few foci of polynuclear leucocytes.

*Four days.* The skin and deeper tissues are much thickened. The epidermis is extensively eroded and the surface of the derma is extensively infiltrated with leucocytes and blood. The loose subdermal tissues show active new growth of spindle cells. The outer layers of muscle tissue show a very active growth of spindle cells approaching the sarcomatous type. Many muscle cells and bundles are completely replaced by such cells.

*Five days.* The main changes are in the subdermal tissues, which are the seat of extensive purulent infiltration. There is extensive overgrowth of new spindle cells in

[1] We are indebted to Dr. James Ewing, professor of pathology in Cornell, for the description of the pathological changes in these sections.

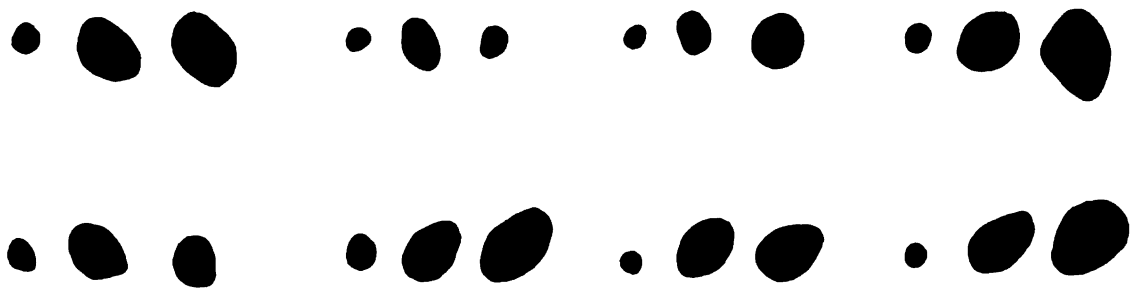


CHART 2

In this chart are represented the events which obtained with four animals. Measurements were made every ten days, beginning ten days after planting. The upper tumors are those in the control area, while the lower ones show the comparative growth obtained in the fulgurated area. Absolutely no effect of the fulguration was noted if the tumors were planted one week after the application of the spark.

If any physiological change in the nutrition of the tissues was caused by the fulguration it must have been transitory and passed coincidently with the healing of the local reaction.

the muscle bundles and considerable extravasated blood.

*Six days.* There is complete destruction of the epidermis by an abundant exudate of pus and blood. Ulceration extends to the subdermal tissues and muscles which are the seat of an active new growth of spindle cells replacing the muscle fibers and thickening the septa.

From the evidence presented as to the nature of the local reaction it seemed to us that we might expect small tumors to be decidedly influenced by fulguration, even if this were done directly through the intact skin. To test this point we chose a number of rats having recently implanted tumors about the size of a small pea and subjected them to fulguration over the tumor area with a suitable spark for a period of from 30 seconds to one minute. Tumors were carefully observed, to determine inhibition of growth or curative effects. In a few instances the tumor was sufficiently injured to prevent additional growth, and after a few days a small scab-like area, representing what had originally been the tumor, was present. Such animals may be considered as cured. In other cases there was a marked inhibition of growth but no actual cure. In these animals it must be remembered that we are dealing with very small tumors, and that only a small percentage of these could be regarded as cured by the process of fulguration. When tumors as large as a chestnut were subjected to fulguration it was found that there was a superficial area of œdema and softening, which was later followed either by ulceration or scab formation. The borders of the tumor continued to grow rapidly, and in no case was it possible to effect a cure in tumors of this size, although they were repeatedly fulgurated. From these experiments it became evident that we could not effect a cure in the rat sarcoma except in the early stages of growth, soon after implantation, and then only occasionally.

In a personal communication, de Keating-Hart stated to one of the writers that fulguration through the intact skin produced such changes as to immunize that particular area to the transplantation of experimental tumors. This point seemed to us to be of sufficient interest to warrant its confirmation. Accordingly, we fulgurated several sets of animals for periods of 30 seconds on the back, between the hips, and immediately after fulguration planted them in the fulgurated area with rat sarcoma. At the same time we planted them with the same tumor on a non-fulgurated area between the shoulders. This experiment was repeated many times, in order to rule out accidental errors; the accompanying chart is made from typical results and shows the various fates of the implanted grafts (Chart 1). In the large majority of the animals the graft planted in the fulgurated area did not grow, while the graft planted in the non-fulgurated area took

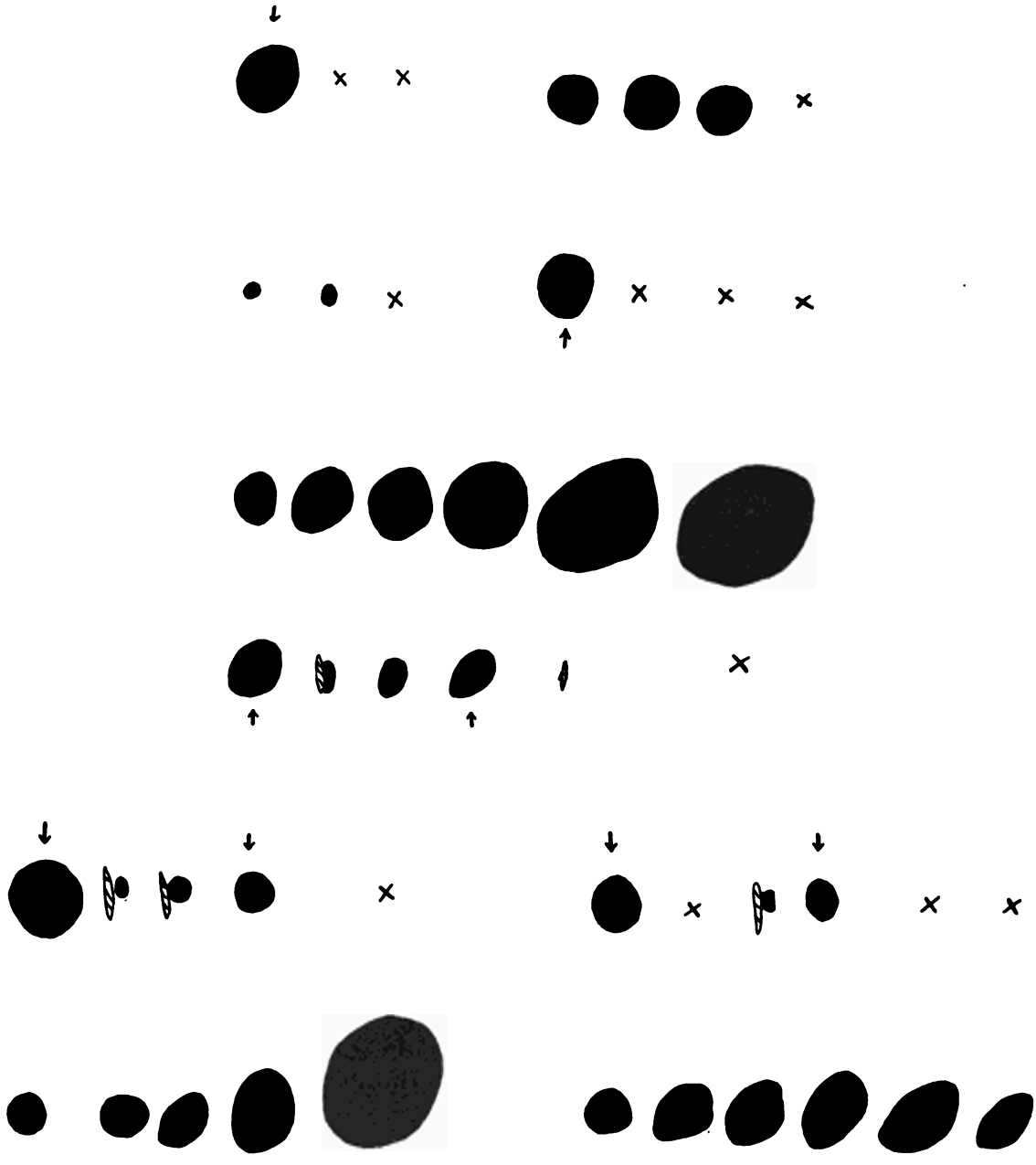


CHART 3

In this chart are shown the results obtained with five rats in which an attempt was made to cure one of the tumors by means of incomplete operation followed by fulguration. The results shown in the diagrams are typical of a large number in which similar experiments were made. The larger of the two tumors was always chosen for operation, and the operation was done upon the tumors and at the time indicated by the small arrow in the chart. The measurements were made at ten-day intervals. The tumors can be cured by this method, but not always at the first attempt; and then precaution must be taken not to leave too large a fragment.

From the previous experiments quoted it seems probable that the cure is dependent upon two factors, viz.: direct injury to the tumor by the spark and the intense reaction following its application.

in the usual way. If by any chance the graft was placed just at the border of the area of reaction following fulguration, it took as readily as the graft in the non-fulgurated area. In a very few instances the graft in the fulgurated area showed positive growth. It was, however, apparent that a tumor graft introduced directly into the area of reaction immediately following fulguration was, in a high percentage of cases, destroyed and absorbed without producing tumor growth.

In order to determine whether this effect was due to the immediate reaction or to some permanent change in the nutritive condition of the fulgurated area, a series of rats were fulgurated precisely as in the preceding experiment, but one week was allowed to elapse after fulguration before the tumor grafts were planted. At the end of this period the reaction had practically all passed, and there was only a slight infiltration of the skin to indicate the fulgurated area. The accompanying chart (Chart 2) shows that under these conditions the tumor grafts take quite as well in the fulgurated area as in the normal area. These charts give typical instances of a large number of animals treated in this way.

It must be evident from such experiments that no permanent nutritional change is produced by fulguration so as to interfere with tumor growth after the immediate local reaction has cleared up.

In the next series of experiments the tumor tissue itself was fulgurated immediately before implantation. A thin slice of freshly removed tumor about 1 mm. thick was fulgurated for 30 seconds, cut into small grafts, and planted immediately into normal rats. In about 50 per cent the grafts showed positive growth, while a non-fulgurated graft of the same tumor gave approximately 100 per cent takes. Further difference was noted in that growth of the fulgurated tumor was much slower, and there was a large percentage of regressions, indicating that the virulence was very much impaired. These results indicate that the injurious effect upon the cells directly is probably much greater than was assumed by de Keating-Hart.

Finally, a long series of experiments was undertaken to determine under what conditions the best therapeutic effect might be expected from fulguration. In these experiments grafts were planted in both the neck and hip region of the rats. When the growth was well established, one tumor was removed by operation except for a small fragment at its base. These remaining fragments were varied in size in the different experiments, in order to determine how large a fragment of growing tumor could be prevented from showing additional growth as a result of fulguration. After the operation the open wound was fulgurated for a period of 30 seconds to one minute, the spark being particularly directed to the tumor fragment left *in situ*. The accompanying chart shows typical experiments in this series (Chart 3).

In a considerable number of these experiments the fulguration of one tumor prevented growth, but it was followed by spontaneous regression of the control growth of the same animal.

The question arises here as to whether or not we have been dealing with animals in which the forces of immunity have been stimulated by the absorption of the fulgurated tumor, or whether we had just caught the tumor at a time when spontaneous regression of both tumors was about to occur. It seems hardly probable that the latter explanation could be the proper one in every instance, and there remains the definite possibility that the tumor has been injured to a sufficient degree to prevent additional growth, and its absorption has been followed by immunity. In by far the larger number of cases, however, the control tumor continued to grow, while the fulgurated tumor was either cured at the first attempt or else it recurred, as it sometimes did, as shown in the accompanying charts, and was cured by subsequent operation and fulguration.

It became evident in this work that the fragment left to be cured by the subsequent fulguration must be a thin one, not more than 1 mm. thick, or recurrence was sure to follow. The curative effect of the spark could not penetrate deeper than that into the tumor tissue. It is evident, therefore, that al-

though it is possible to cure rapidly growing rat sarcoma by operation and fulguration, it cannot be concluded that such happy results would follow the application of this method to growths which have infiltrated normal tissue beyond the borders of the gross tumor. It could scarcely be expected that tumor cells in the lymphatics at the border of a tumor would be seriously injured by the effect of the spark applied some millimeters distant.

It does not seem to be necessary to invoke some obscure nutritional change to explain the effect of fulguration when the severe local reaction following the spark is quite sufficient to account for the phenomena noted.

---

# URINARY INCONTINENCE IN WOMEN, WITHOUT MANIFEST INJURY TO THE BLADDER

## A Report of Cases

By HOWARD A. KELLY, M. D., Baltimore
Professor of Gynecology, Johns Hopkins University
AND
WILLIAM M. DUMM, M. D., Baltimore
Assistant Resident Gynecologist, Johns Hopkins Hospital

THERE is a type of urinary incontinence in women, without manifest injury to the bladder and having no relation to fistula, which most frequently comes on following childbirth, but is occasionally seen in nulliparæ. In our series of 20 cases, 85 per cent were among women who had borne children, while 15 per cent were nulliparæ. Two were post-operative: in one, a nullipara, incontinence followed an operation for tumor of the bladder; the other had incontinence following an operation for cystocele and relaxed vaginal outlet. In two cases there was an occasional dribbling of urine on standing or sudden exertion, which condition had been present from childhood. It is a disease of middle life: 55 per cent of the cases were in the fourth decade. As stated by Cumston (1), some women progressively develop an incontinence of urine when no history of a surgical or obstetrical nature can be elicited. It is mostly in elderly women that this unfortunate affliction arises, occasionally at about the time of the menopause.

The onset of this affection generally manifests itself, first, by an occasional escape of a few drops of urine following some unusual exertion. Later, gushes of urine follow coughing, sneezing, laughing, stooping, or walking; which may ultimately lead to an absolute loss of control, compelling the patient to wear some kind of protection constantly to prevent her clothes being wet and soiled with malodorous secretions. Describing this condition, Farquharson (2), says that but few infirmities are productive of so much inconvenience and mental depression or interfere so gravely with the present comfort and future prospects of its victims.

To summarize, one may call it, in general, an affection beginning in middle life, most common in multiparæ. It begins as a rule with slight leakage, which gradually grows worse, leading to complete incontinence with all its unfortunate and repellent sequelæ. It is not cured by any known means, and although numerous operations have been devised no one has been pre-eminently successful.

The methods of treatment for urinary incontinence have been legion, and we find some of the earlier procedures (3), very crude, such as ligation of the prepuce, the use of pressure bandages, and painting of the external meatus of the urethra with collodion. The most popular forms of hydrotherapy (4),

which have been in use are: The cold-water foot-bath for five minutes, cold hypogastric douches for five or ten seconds, lumbar affusions, aromatic baths, and vaginal douches. Dieting, hygienic measures, counter-irritation by means of blisters, injection of the sacral nerves (Cathélin), lumbar puncture, subarachnoid mercurial injections, epidural injections of sterile water or salt solution, cauterization, tampons, pessaries (5), massage, and the use of electricity have played an important part in the treatment of incontinence. Therapy, by the use of ergot, pituitrin, belladonna, hyoscyamus, strychnia, tincture of iron, tincture of cantharides, santonin, chloral hydrate, potassium bromide, etc., has not received minor attention.

Many operations have been devised in the surgical treatment of urinary incontinence in women, and they may be classified as follows:

A. Those which serve to create an artificial channel which can be placed under voluntary control.

B. Operations which restore the urethra with the normal power of retention.

In the first group three operations are described.

1. Procedure of Baker Brown (6). A puncture is made under the arch of the pubis with a knife or trocar. An artificial channel entering the bladder is thus formed, into which a catheter is introduced. The patient wears an ingenious apparatus which serves to keep the catheter in good position and the urine under control.

2. Procedure of Rutenberg (7). This surgeon closed the urethra and established a vesico-abdominal fistula. Control was obtained by means of a large pledget or ball-valve closing the mouth of the sinus.

3. Procedure of Rose (8). A rectovaginal fistula is made, following which a plastic operation is performed on the vagina, completely closing it. The control of the urine is effected by means of the sphincter ani.

All other operations may be described as belonging to the second group, and prominent among them are the following procedures:

Simple compression of the urethra by anterior colporrhaphy.

Periurethral injections of paraffin. The use of an unabsorbable foreign body and the dangers arising from emboli have been the chief objections to this method. Also, the result in the hands of most operators has only been that of temporary improvement.

From the anterior vaginal wall, near the cervix, Schultze (9) excised an elliptical area 3 cm. long by 1 cm. broad at its widest point, and then narrowed the lumen of the urethra and the vesical neck.

Frank's (10) procedure is to place a small catheter in the urethra and then excise a wedge-shaped piece from the posterior urethral wall, including vaginal and urethral mucosa, and extending from the external urethral orifice to a point within 1 cm. of the internal orifice. The incision is now continued in an elliptical form on the vaginal wall beyond the neck of the bladder. The whole wound surface is approximated by a transverse row of interrupted sutures. The anterior two-thirds of the relaxed canal of the urethra has thus been resected, and the elliptical portion of the denudation has formed a buttress behind the neck of the bladder.

Winckel (11) removed a wedge-shaped flap from the anterior vaginal wall, the narrowest portion of which corresponded to the mucosa of the urethra.

Engström (12) removed a triangular flap of vaginal mucous membrane the apex of which corresponded to the neck of the bladder. The excision on the vaginal septum is carried down to the urethral mucosa, yet does not include it.

Transverse folding of the urethra was done by Desnos (13). He used a catheter in the bladder as a guide, and cut through the vaginal mucosa, exposing the upper two-thirds of the urethra; this portion was then dissected out, and a large catgut suture was placed 2 or 3 mm. from the neck of the bladder and tied so tight that the catheter could just be moved. The vaginal incision was closed with silkworm gut.

Pawlick (14) initiated the attempt to control incontinence by bringing the walls of the urethra in close permanent apposition by bending and flattening the outer end of the urethra. The external orifice of the urethra

## CASES OF URINARY INCONTINENCE OPERATED UPON AT THE JOHNS HOPKINS HOSPITAL AND DR. KELLY'S SANATORIUM

| Serial No. Gyn. No. Date. | Age. Race. Preg. Duration and type of incontinence. Operations. | Diagnosis. | Operation. | Immediate result (on discharge from hospital). | Late result. |
|---|---|---|---|---|---|
| 1<br>946<br>Apr. 8, 1900 | 35 yrs.; white; I-para; instrumental delivery, followed in 2 mos. by complete incontinence on standing; duration, 3 yrs. | Urinary incontinence; relaxed vaginal outlet. | Anterior colporrhaphy; suture of vesical sphincter. | Well, June 6, 1900. | Not located. |
| 2<br>1092<br>Jan. 31, 1901 | 29 yrs.; white; nullipara. Occasional incontinence when standing, for "years." | Urinary incontinence. | Anterior colporrhaphy; suture of vesical sphincter. | Well, June 20, 1901. | Well, July 25, 1913. |
| 3<br>1155<br>Apr. 25, 1901 | 21 yrs.; white; nullipara. "Incontinence since a child." | Urinary incontinence. | Anterior colporrhaphy; suture of vesical sphincter. | Improved; "Incontinence twice before leaving hospital." | Well, April, 1902. |
| 4<br>1690<br>Mar. 3, 1904 | 48 yrs. white; III-para; labors prolonged and difficult. Incontinence on coughing, sneezing, and sudden exertion; duration, 4 yrs.; one unsuccessful operation for incontinence. | Urinary incontinence; descensus uteri; retroposition of uterus; relaxed vaginal outlet. | Amputation of cervix; anterior and posterior colporrhaphy; suture of vesical sphincter. | Well, April 3, 1904. | Well, Oct. 8, 1913. |
| 5<br>1744<br>June 1, 1904 | 48 yrs.; white; nullipara. Partial incontinence following operation for tumor of the bladder; duration, 7 yrs. | Urinary incontinence (post-operative); prolapsus of vaginal walls. | Narrowing of urethra; suture of vesical sphincter. | Well, July 6, 1904. | Not located. |
| 6<br>1887<br>Mar. 30, 1905 | 42 yrs.; white; II-para (15 & 11); 1st delivery instrumental. Incontinence when standing and on coughing and sneezing; duration, 13 yrs. | Urinary incontinence; relaxed vaginal outlet. | Anterior and posterior colporrhaphy; suture of vesical sphincter. | Well, April 26, 1905. | Improved, July 24, 1913; "almost complete control for 6 yrs.; occasional incontinence on sudden exertion, for past 2 yrs." |
| 7<br>3646<br>Mar. 2, 1911 | 42 yrs.; white. Occasional incontinence when standing, "of several years' duration." | Relaxed vesical sphincter; relaxed vaginal outlet. | Anterior and posterior colporrhaphy; suture of vesical sphincter. | Well, March 30, 1911. | Improved, July 23, 1913; "occasional incontinence now on exertion." |
| 8<br>3691<br>Apr. 12, 1911 | 60 yrs.; white; I-para (30); menopause at 48 yrs. Incontinence on coughing and sudden exertion; duration, 2 yrs. | Urinary incontinence; prolapsus uteri. | Vaginal fixation of uterus (Wertheim); suture of vesical sphincter; posterior colporrhaphy. | Well, May 8, 1911. | Improved, Aug. 3, 1913; "no return of trouble for 1 yr.; "occasional incontinence on sudden exertion." |
| 9<br>3720<br>May 3, 1911 | 39 yrs.; white; III-para (17, 15, & 11). Incontinence on coughing or sneezing. | Urinary incontinence. | Repair of vesical sphincter. | Well, May 30, 1911. | Improved, Aug. 1, 1913; complete control for 13 mos.; occasionally incontinence after sudden effort. |
| 10<br>3731<br>May 15, 1911 | 32 yrs.; white; I-para (4). Occasional incontinence on exertion since birth of child; worse since plastic operation on urethra 16 mos. ago. | Urinary incontinence, with relaxed vesical sphincter; relaxed vaginal outlet. | Suture of vesical sphincter; repair of relaxed vaginal outlet. | Well. May 29, 1911. | Not located. |
| 11<br>3914<br>Feb. 16, 1912 | 48 yrs.; white; II-para (20 & 18). Incontinence on coughing, sneezing, and when walking. | Relaxed vesical sphincter; relaxed vaginal outlet. | Oval resection of anterior vaginal wall; suture of vesical sphincter; repair of relaxed vaginal outlet. | Well, Mar. 9, 1912. | Improved, July 25, 1913; "complete control for 6 mos.; occasional incontinence on sudden exertion, but very materially improved." |
| 12<br>3989<br>Mar. 21, 1912 | 40 yrs.; white; II-para (12 & 6); both stillborn and instrumental deliveries. Incontinence for 14 yrs.; no control for 6 yrs.; two unsuccessful plastic operations; before marriage, slight incontinence on sudden exertion. | Incontinence of urine, due to relaxation of vesical sphincter. Prognosis: poor; sphincter badly lacerated. | Repair of vesical sphincter. | Improved for several weeks. | Unimproved, Sept. 3, 1913; one operation since (unsuccessful). |
| 13<br>4003<br>Mar. 30, 1912 | 41 yrs.; white; IV-para (17 & 9). Occasional incontinence on stooping, coughing, and when walking; duration, 2 yrs. | Relaxed vesical sphincter; relaxed vaginal outlet. | Suture of vesical sphincter; repair of relaxed vaginal outlet. | Well. | Well, July 24, 1913. |

CASES OF URINARY INCONTINENCE — *Continued.*

| Serial No. Gyn. No. Date. | Age. Race. Preg. Duration and type of incontinence. Operations. | Diagnosis. | Operation. | Immediate result (on discharge from hospital). | Late result. |
|---|---|---|---|---|---|
| 14<br>4056<br>Apr., 1912 | 42 yrs.; white; II-para (16 & 14), first stillborn; instrumental delivery; perineal repair 1 yr. following. Incontinence on coughing or straining; duration, 16 yrs. | Urinary incontinence, due to relaxed vesical sphincter. | Anterior colporrhaphy; suture of vesical sphincter. | Unimproved. | Unimproved, July 27, 1913. |
| 15<br>4330<br>Mar. 12, 1913 | 42 yrs.; white; II-para (17 & 9). "Constant flow of urine since birth of last child." Birth at term; normal labor. | Relaxation of vesical sphincter; relaxed vaginal outlet. | Anterior and posterior colporrhaphy; suture of vesical sphincter. | Well. | Well, July 26, 1913. |
| 16<br>4715<br>May 14, 1913 | 64 yrs.; white; IV-para. Developed incontinence 2 yrs. ago, following operation for cystocele and relaxed vaginal outlet. | Relaxed vesical sphincter. | Anterior colporrhaphy; suture of vesical sphincter. | Well. | Well, July 30, 1913. |
| 17<br>17129<br>Nov. 23, 1910 | 45 yrs.; white; III-para. Incontinence of 13 yrs.' duration; complete for 3 yrs., following vaginal suspension of uterus. | Urinary incontinence; relaxed vaginal outlet. | Suture of vesical sphincter. | Improved; "no control except when lying down;" Dec. 11, 1910. | Unimproved; July 27, 1913, "better control for several mos.; another operation since (unsuccessful)" |
| 18<br>18469<br>June 16, 1912 | 51 yrs.; white; V-para; all deliveries instrumental. Incontinence on coughing, sneezing or sudden exertion. | Urinary incontinence; relaxed vaginal outlet; subinvolution of uterus. | Anterior and posterior colporrhaphy; suture of vesical sphincter. | Well. | Improved, July 22, 1913; "occasional incontinence only on exertion." |
| 19<br>18873<br>Nov. 19, 1912 | 47 yrs.; white; X-para. Complete incontinence for 4 yrs. | Urinary incontinence; relaxed vaginal outlet. | Anterior and posterior colporrhaphy; narrowing of urethra; suture of vesical sphincter. | Improved; "almost complete power to retain urine." | Unimproved, July 22, 1913; "better control for 2 mos." |
| 20<br>19308<br>May 11, 1913 | 25 yrs.; white; II-para; forceps delivery 13 mos. ago. Incontinence of urine for 13 mos.; complete for 3 mos. | Urinary incontinence; descensus uteri; relaxed vaginal outlet; hypertrophied cervix. | Anterior and posterior colporrhaphy; suture of vesical sphincter; vaginal suspension of uterus; amputation of cervix. | Well, June 1, 1913. | Well, Sept. 5, 1913. |

ANALYSIS OF SUCCESSFUL OPERATIONS FOR URINARY INCONTINENCE. RESULT — WELL

| Serial No. Gyn. No. | Age | Preg. | Instrumental deliveries | Type of incontinence; duration | Time elapsing since operation |
|---|---|---|---|---|---|
| 1<br>946 | 35 | 1 | 1 | Complete when standing; duration, 3 yrs. | Discharged well, 13 yrs. 4 mos. ago. |
| 2<br>1092 | 29 | 0 | 0 | Partial | 12 yrs. 6 mos. |
| 3<br>1155 | 21 | 0 | 0 | Partial; "since a child." | 1 yr. |
| 4<br>1690 | 48 | 3 | 0 | Partial (4 yrs.); one unsuccessful operation for incontinence. | 9 yrs. 7 mos. |
| 5<br>1744 | 48 | 0 | 0 | Partial (post-operative); duration, 7 yrs. | Discharged well, 9 yrs. ago. |
| 6<br>3731 | 32 | 1 | 0 | Partial (4 yrs.); one unsuccessful operation for incontinence. | Discharged well, 2 yrs. ago. |
| 7<br>4003 | 41 | 4 | 0 | Partial; duration, 2 yrs. | 1 yr. 4 mos. |
| 8<br>4330 | 42 | 2 | 0 | Complete; duration, 9 yrs. | 4 mos. |
| 9<br>4715 | 64 | 4 | 0 | Partial (following cystocele operation); duration, 2 yrs. | 4 mos. |
| 10<br>19308 | 25 | 2 | 1<br>second del. | Complete; duration, 3 mos.; (incontinence 13 mos.). | 5 mos. |

ANALYSIS OF SUCCESSFUL OPERATIONS FOR URINARY INCONTINENCE. RESULT—IMPROVED

| Series No. Gyn. No. | Age | Preg. | Instrumental deliveries | Type of incontinence; duration | Time elapsing since operation |
|---|---|---|---|---|---|
| 1 1887 | 42 | 2 | 1 first del. | Partial; duration, 13 yrs. | 8 yrs. 4 mos. |
| 2 3646 | 42 | ? | ? | Partial; "several yrs." | 2 yrs. 5 mos. |
| 3 3691 | 60 | 1 | 0 | Partial; duration, 2 yrs. | 2 yrs. 4 mos. |
| 4 3720 | 39 | 3 | 0 | Partial. | 2 yrs. 3 mos. |
| 5 3914 | 48 | 2 | 0 | Partial. | 1 yr. 5 mos. |
| 6 18469 | 51 | 5 | 5 | Partial. | 1 yr. 1 mo. |

FURTHER ANALYSIS OF THE RESULTS IN CASES OF URINARY INCONTINENCE

| Result | Immediate Result | | | Late Result | | |
|---|---|---|---|---|---|---|
| | Number of cases | Per cent | | Number of cases | Per cent | |
| Well | 15 | 75 | 90 | 7 | 35 | 65 |
| Improved | 3 | 15 | | 6 | 30 | |
| Unimproved | 2 | 10 | | 4 | 20 | |
| Not Located | .. | .. | | 3* | 15 | |

* Discharged well.

is drawn well forward toward the clitoris and sharply to one side; then, after marking the point on that side to which it can be drawn without excessive tension, a long narrow denudation is made and sutures placed holding the urethra in position. After one week the other half of the urethra is treated in the same manner. This procedure was later modified by Duret (15).

Torsion of the urethra was first employed by Gersuny (16), who, after dissecting out the entire urethral canal twisted it on itself in an attempt to form a series of obliquely spiral folds dovetailing each other. He then sutured it in position. A fine bougie was inserted in the canal of the urethra to assure the operator that the lumen was not entirely obliterated.

After introducing a bougie into the urethra, Pousson (17) resects the external meatus and a portion of the urethra. After torsion of the canal through 180° it is transplanted to a point just below the clitoris.

Albarran's (18) procedure is quite similar to that of Pousson, the chief difference lying in the longitudinal invagination as a means of narrowing the lumen of the urethra rather than torsion. The canal of the urethra is dissected out and transplanted below the clitoris.

Dudley (19) published an operation in 1905, the principle of which is the same as that involved in the operations of Pousson and Albarran, i.e., advancement of the meatus urinarius to the clitoris. His procedure, however, obviates the danger of sloughing of the urethra, as he advances the external orifice without dissecting the urethra free. The operation is described in two steps, as follows:

(*a*) A horseshoe-shaped surface is rather deeply denuded between the meatus urinarius and the clitoris, and to either side of the urethra throughout the entire length of it.

(*b*) The meatus is drawn up to a point near the clitoris and is secured there by means of two sutures. The lateral portion of the denuded surfaces is now closed. Thus the sagging, displaced urethra is replaced and retained in its functional relations.

He states that in many cases it will be necessary to combine with the operation some appropriate treatment for an associated cystocele, and in nearly all cases to perform perineorrhaphy to relieve relaxation of the posterior vaginal outlet. Five cases were reported, and in all the relief was immediate. Five months' time, however, was the longest period any one case had been observed.

For the past thirteen years, Kelly has adopted an operative procedure which we believe has been more successful than any yet proposed. This affection is due to the loss of elasticity or normal tone of the urethral and vesical sphincter, so well shown by the cystoscopic picture, which in many cases presents a gapping internal sphincter orifice which closes sluggishly as the cystoscope is withdrawn. The point of vantage toward which the operative treatment should be directed is the internal orifice of the urethra and the sphincter of the bladder. The operation (20) which has been described by Kelly may be performed under local or general anæsthesia, and is as follows:

A Pezzer catheter with a stem not over 5 mm. in diameter is introduced into the bladder. With the patient in the lithotomy position and slightly elevated, the posterior wall of the vagina is retracted, and the area at the neck of the bladder is brought down by means of forceps or four tension sutures.

The next step consists in slitting the vaginal wall down to the urethra and the bladder in the median line for about 3.5 or 5 cm. The neck of the bladder should fall at about the center of the incision. The position of the bladder sphincter is easily determined at all times by moving the catheter to and fro, and feeling its head, which presses closely against the urethra. The utmost care should be taken not to cut the urethra or the bladder at any step of the operation. After making this median incision, the vagina is further detached on both sides, with tissue forceps and scalpel or a blunt dissector, and dissected away for a distance of 2 to 2.5 cm. around the neck of the bladder. This may also be done with blunt pointed scissors, which push their way into the tissues, separating the bladder from the vaginal walls. The dissection should be deepest at the neck of the bladder. With the detachment of vagina from bladder completed, the finger should be able to grasp at least one-half or two-thirds of the neck of the bladder including the contiguous urethra. Sometimes the bladder wall is so thin in the median line, due to the rupture of its muscle fibers, that its mucosa shines through.

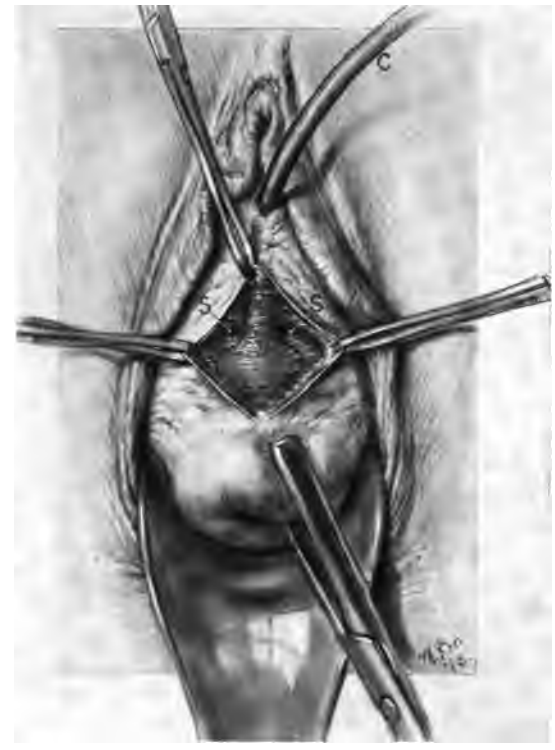



Fig. 1. SS—Position of bladder sphincter, which is determined by means of a Pezzer catheter.

The torn or relaxed tissues at the vesical neck should then be sutured together, using two or three mattress sutures of fine silk or linen, passed from side to side: the first suture, taking in about 1.5 cm. of tissue, is tied at once and may be used as a tractor; the succeeding one is applied on the outside of this. further contracting and bringing together the tissues at the neck. This is the essential part of the operation, and when done, the mushroom catheter should be removed. The head of the catheter escapes with a little jump as it clears the tightened, reconstructed sphincter area. The more or less redundant vaginal walls, which have been detached in order to expose the sphincter area, are now resected so that the remaining tissues can be snugly brought together from side to side, thus supporting the vesical area operated upon and avoiding dead space between bladder and vagina. This suturing is best done with a continuous fine catgut suture in one or two layers. In some cases it may

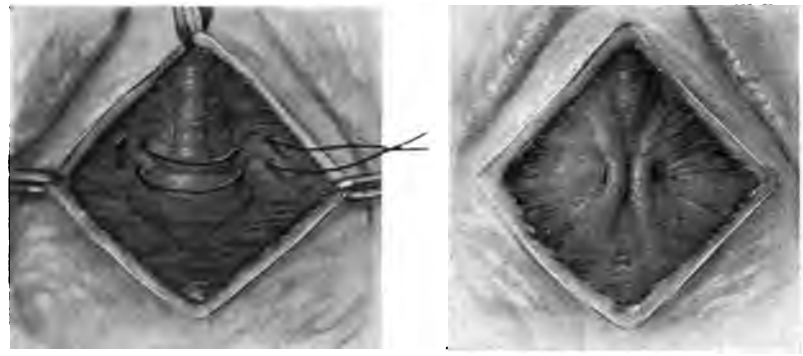


Fig. 2. Method of insertion of the mattress sutures at the vesical neck. First suture tied.

be advisable to repair the relaxed posterior vaginal outlet.

The post-operative treatment is simple. The patient should not be catheterized unless it is imperative, although sometimes it must be done for several days, or even for a week. A Gatch bed with a half-way-up posture should be used immediately after operation.

Twenty cases have been operated upon for urinary incontinence and of this number sixteen were successful. With the exception of one case (Gyn. No. 1887) in the list of patients designated as improved, all have practically complete control; yet an occasional incontinence on sudden exertion forces us to place them in the "improved" column. Communications have been received from all excepting three whose operations were performed two, nine, and thirteen years ago, respectively. They were discharged well.

There were four cases in which the operation was not successful. All were multiparæ. Three had previous operations: one, two unsuccessful plastic operations for incontinence; another, a perineal repair; the third, a vaginal suspension of the uterus, following which there was complete incontinence. Prior to operation, incontinence was complete in three cases for periods varying from three to six years. The prognosis was exceedingly unfavorable in all, because of the presence of dense scar-tissue in the vaginal vault and at the site of the vesical sphincter.

## CONCLUSIONS

1. There is a type of urinary incontinence in women, with no manifest injury to the bladder, which is due to an impairment of the function of the sphincter muscle at the internal orifice of the urethra. It is most common among multiparæ in the fourth decade.

2. The operation as performed by Kelly is the most satisfactory thus far suggested for this type of incontinence. Entire control is given in a large percentage of cases by means of a mechanical restoration of the sphincter area at the vesical neck. Operation may be under local or general anæsthesia.

## BIBLIOGRAPHY


1. Cumston, C. G. Med. News, 1904, lxxxiv, 109.
2. Farquharson, R. Practitioner, Lond., 1879, xxiii, 7.
3. Neveu. Thèses, Paris, 1880.
4. Espagne. Gaz. méd. de Paris, 1871, May 16, No. 50.
   Corrigan. Gaz. hebd. d. méd. et d. chir., 1870, April 29.
5. Schatz, F. Arch. f. Gynäk., 1877, xi, 198.
6. Baker Brown. Lancet, Lond., 1864, Mar. 5.
7. Rutenberg. Wien. med. Wchnschr., 1875, No. 37.
8. Pepin, E. A. "Pathogenie et traitement opératoire de l'incontinence urethrale d'urine chez la femme." These, 1893, 42.
9. Schultze, B. S. Cor.-Bl. d. allg. ärztl. Ver. v. Thüringen, Weimar, 1888, xvii, 289.
10. Frank. Zentralbl. f. Gynäk., 1882, No. 9.
11. Winckel, F. München. med. Wchnschr., 1886, xxxiii, 1.
12. Engström. Berl. klin. Wchnschr., 1887, No. 40.
13. Desnos, E. Ann. d. mal. d. v. Gen.-urin., 1890, No. 6.
14. Pawlick, Karl. Wien. med. Wchnschr., 1883, Nos. 25-26.
15. Duret. J. d. Sc. méd. de Lille, 1891, No. 4.
16. Gersuny. Zentralbl. f. Chir., 1889, No. 25.
17. Pousson. Arch. clin. d. Bord., 1892, No. 1.
18. Albarran, M. J. Ann. d. mal. d. org. Gen.-urin., 1892, Oct.
19. Dudley, E. C. Tr. Am. Gynec. Soc., 1895, xxx, 3.
20. Kelly, H. A. Urol. & Cutan. Rev., 1913, 291.
21. Kelly, H. A. "Operative Gynecology," 1912, i, 375.

# FIBROID TUMORS OF THE OVARIES

## Report of a Case

By WILLIAM D. FULLERTON, Ph. B., M. D., Cleveland, Ohio
Resident Gynecologist, Lakeside Hospital

FIBROUS tumors of the ovaries have long been recognized, since in 1799 Baillie made illustrations of them and stated that their texture resembled exactly that of uterine fibroids. Madame Boivin (1), in 1834, stated that "fibrous tumors are sometimes attached to the ovarium as well as to the uterus." Kiwisch (2), about 1845, merely mentions that we find solid fibroids of the ovaries. Virchow's short section on the subject in his "Geschwülste," among the earliest accounts of these tumors, mentions that they are found in domestic animals. Lepold (3), in 1876, records an incomplete list of 59 cases, 19 of which were fibrous and probably included some sarcomata. Coe (4), in 1882, collected 20 additional cases.

As stated by Henrolin (5), pure fibromata of the ovaries are very rare; and considering the great difficulty at times of differentiating benign and malignant solid ovarian tumors, even to the best present-day pathologists, it is more than likely that many reported cases, the pathology of which is often scarcely mentioned or but vaguely alluded to, were either sarcomatous in nature or comprised various modifications such as myofibroma, adenofibroma, fibrocystoma, fibro-adenocystoma, etc., which are much more common, though fibrous tissue usually predominates.

When knowing, as we do, that pure fibromata of the ovaries are infrequent even among tumors containing more or less fibrous tissue, their rarity may be estimated from the report of Cohen (6), who gives the frequency of sarcoma as compared to that of cystic ovarian tumors as one per cent; of Schröder, one and a half per cent of ovarian tumors; and of Pfannenstiel (7), who states that fibrous ovarian tumors constitute only two to three per cent of the solid ovarian tumors.

There is a variation of opinion as to the age at which any fibrous tumors of the ovaries are most common. Uterine fibroids are more common during menstrual life; and Coe (8) considers ovarian fibroids products of youthful and active, not of senile ovaries, whereas Bland-Sutton (9) believes they arise more often later in life. Considering the physiology and normal histology of the ovary at these periods, I am inclined to side with Coe in his conclusions.

Ovarian fibromata vary in size from mere granules to large tumors weighing thirty to forty pounds, the smaller ones being much the more common and probably originating at times in the corpus luteum. I believe that, except in rare instances, when they may be parasitic from the uterus or other pelvic structures, they are primary in the ovary and are a hypertrophy of the pre-existing ovarian stroma, originating in a single focus and increasing uniformly, except occasionally, when some areas increase more rapidly than others, which gives a nodular and even pedunculated growth.

In the gross they closely resemble uterine fibroids; they are usually unilateral, single, restricted to the ovary, and regular in contour; the growth is slow and the general shape of the ovary retained, they being ovoid or rounded, as a rule, although often slightly lobulated and circumscribed nodular, warty, and papillary forms do occur. Unless quite large, a small remnant of ovarian tissue can usually be found at the hilum. They vary in consistency; in the absence of degenerations the more fibrous tissue they contain the harder they are. The surface is smooth, glistening, and gray-white in the absence of congestion by torsion of the ovarian pedicle or otherwise, or when not changed by more or less degeneration.

On section, in the absence of retrogressive changes, they also resemble uterine fibroids, being tough, somewhat elastic, milky white

in color, and presenting a whorl-like texture resulting from the interlacing fibrillary connective-tissue bundles running in all directions. Encapsulation is almost invariably present, though the capsule may be very thin and be separated with more or less difficulty. Pathologists in general attach considerable importance to this point when differentiating in the gross from a malignant growth.

Various retrogressive changes may be present. There may be cystic degeneration from dilated glands, blood or lymph-spaces or by liquefaction necrosis. Coe believes the "geodes" or early cystic areas in fibromata are dilated lymph-spaces, occasionally lymph-vessels, into which cells wander and increase in size with finally resulting degeneration of the fibrous tissue. Should there be dilatation of the blood-spaces the tumor would be more or less hæmorrhagic. Calcification also occurs, but, as Whitridge Williams has shown, no true bony tissue is formed. Malignant changes in an originally benign growth are proportionately no more uncommon than in the uterus, and usually are sarcomatous in nature.

Ascites is frequently of early occurrence, for from the weight of these tumors, which is disproportionate to their size, they often become impacted in the pelvis, irritating the rectum, bladder, and peritoneum. Ascites and necrosis are both more likely to occur when there is torsion of the tumor pedicle. If the pedicle be not entirely occluded, arterial blood is pumped in, but there is less venous return, with resulting congestion, serous effusion, and escape of blood into the tumor, and even into the peritoneal cavity.

The frequency of ascites is responsible for these growths rarely becoming adherent to adjoining structures.

Of greatest importance is the differentiation of these benign fibromata from sarcomata. Before operation this may be impossible in the absence of metastases, cachexia, etc., which makes the condition hopeless. It is, therefore, the duty of the surgeon to make the differential diagnosis at operation; and even then it may be difficult, if not impossible, as these tumors have many points in common.

The history of the case is important, for although sarcomata may occur at any age, they are more common in infancy and adolescence, whereas fibromata occur usually during the reproductive period. Fibromata are of much longer duration and are slower in growth than sarcomata, which enlarge rapidly. In the absence of pain, fever, etc., resulting from infection or necrosis of a pre-existing tumor, a rapid increase in size of a long harbored, firm, movable tumor would lead one to suspect a malignant transformation. Sarcomata are frequently bilateral and metastasize early to the uterus, opposite ovary, etc.; whereas fibromata are usually unilateral and, being benign, do not metastasize. Sarcomata resemble in general the form, size, and color of the fibromata of the ovary, except that the surface is smoother and it is not so often nodular in outline. The color is more a yellowish white, and the minute yellowish areas of necrosis which appear on section are heavily in favor of sarcomata. Sarcomata may be gray or pinkish on section, depending on the blood supply, which is here more pronounced than with the usual fibrous growths. The consistency of sarcomata varies, depending upon the type and the amount of fibrous tissue present. The spindle-cell variety is firm, but as a rule softer than fibromata, and the round-cell type is sometimes as soft as brain matter. Ascites and the lack of adhesions are common to both of these tumors. Sarcomata may be encapsulated, but are not as a rule.

The matter of treatment is not difficult: if the growth is merely fibrous, simple unilateral oöphorectomy, or even resection, is sufficient; but if it be sarcomatous, the uterus and lateral structures on both sides should all be completely removed.

The following case presented several diagnostic difficulties and proved unusual in that the microscopic examination showed it to be composed entirely of fibrous tissue.

The patient (Mrs. O.—Gyn. No. 5226) was a woman of 54, married 33 years, IV-para; youngest child 22 years old, though she had had an abortion at three months, one year ago. Menstruation had been normal, though the menopause nine months

Fig. 1. Pure fibroid of the ovary, split through its long axis distal to attachment of its pedicle. A, B, C, areas from which blocks were cut (See Figs. 2, 3, and 4).

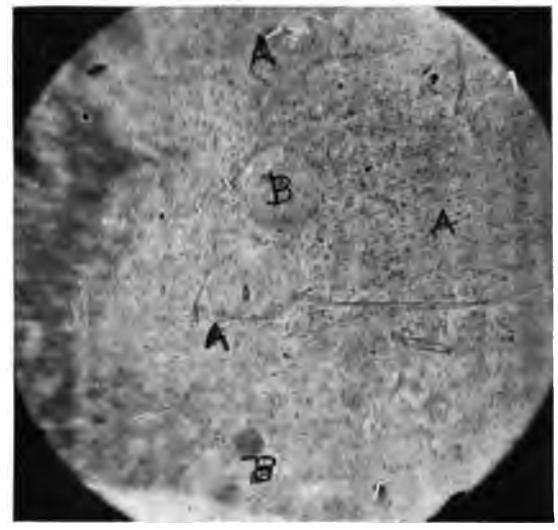



Fig. 2. Section from block A, Fig. 1: A, A, A, homogenous, slightly granular débris; B, B, blood-spaces, the walls of which show no cellular structure. The light fibrous reticular network is not well seen here.

ago was preceded by irregularities of the flow. There had been no subsequent bleeding and but a slight leucorrhœa. She entered the hospital complaining of a tumor in the lower abdomen; some recent headache; an umbilical hernia; some dull aching on voiding, and constipation. She had recently lost considerable weight, and had had more or less dull aching in her lower abdomen, with occasional sharp pain in that region. She had suspected an abdominal tumor for about a year, and had been certain of it for the past four weeks.

*Physical examination.* The family, past, and personal histories were unimportant, as was the physical examination, except that the abdomen, which was somewhat distended, was regular and symmetrical in outline. There was slight movable dulness in the flanks but tympany at the greatest prominence of the abdomen, in the region of the umbilicus, through which there was a small reducible hernia. In the lower abdomen, most prominent in the midline, there was an oval, hard, movable tumor reaching as high as the umbilicus. The kidneys were not palpable, nor were there any signs, symptoms, or history of gall-bladder trouble or involvement of the appendix.

*Pelvic examination.* The outlet was relaxed; the cervix lay in the axis of the vagina and contained a small pedunculated polyp. The uterus was sagging in the pelvis; small and freely movable. Left tube and ovary small and movable; right tube and ovary not made out. The tumor was above the brim of the pelvis and could not be pushed down into it. The urine was normal; w. b. c., 6700 per cmm.; Hb. 80 per cent; B. P. 150 mm. Hg.

*Operation.* Bilateral salpingo-oöphorectomy, appendicectomy, repair of umbilical hernia, and separation of adhesions. The abdomen was scrubbed with soap and water, alcohol, ether, and bichloride, and then opened in the midline below the umbilicus. An oval tumor of the right ovary the size of a grape fruit was found, which was slightly adherent to the omentum; these adhesions were separated. There was considerable blood-stained fluid in the abdominal cavity. A further description of the organs is given in the pathological report.

The tumor had an elongated pedicle of broad and ovarian ligaments, which were twisted several times. There was no sign of lymphatic enlargement or metastases. The pedicle was tied off with silk and plain gut. The appendix was normal and was removed. The gall-bladder contained two stones the size of hazel-nuts; but these were not removed, as the patient's condition did not warrant doing so. The umbilical hernia was resected and the abdomen closed in tiers. The patient's recovery was uneventful and she left the hospital on the twenty-seventh day, feeling quite well.

PATHOLOGICAL REPORT

*Specimens.* Both tubes, an ovary, and a firm ovoid tumor.

*Right Ovary.* The tube and ovary were removed *en masse*, with an elongated pedicle of broad ligament which showed evidence of torsion. The ovary (Fig. 1) was oval in shape, very firm in consistency, measured 10 x 10 x 17 cm., and weighed 850 gm. Its surface was smooth, slightly irregular, and glistening, except for an area three times the

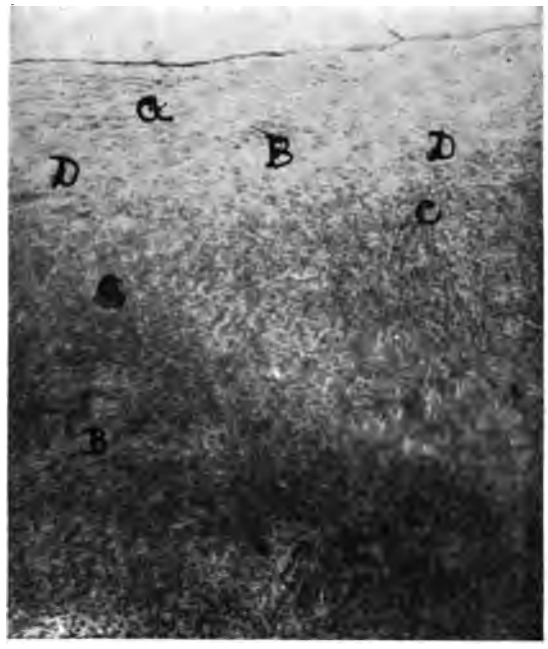



Fig. 3. Section from block B, Fig. 1: A, capsule of fibrous tissue, between the fibers of which are many free red blood-cells; B, B, blood-vessel; D, no very definite demarcation between the capsule and more cellular fibrous tissue beneath; C, C, denser fibrous connective tissue.

size of a postage-stamp, to which several tags of omentum were adherent. The color was a gray-white except on the convexity opposite the attachment of the pedicle, where it was deeply congested and showed dilated vessels beneath the peritoneal covering. On section, the tumor was found to be encapsulated, though the capsule varied in thickness and stripped with more or less difficulty. The cut-surface was tough and fibrous, without evidence of necrosis. The superficial congestion mentioned extends deep into the tumor-tissue and is a deep, raw, beefy red 1 to 2 cm. beneath the surface, gradually shading off until colorless at the bottom of the incision, just within the attachment of the pedicle. The congestion is seen at C (Fig. 1). The right tube measured 11 cm. in length and 0.5 cm. in diameter, was thatched with prominent vessels, and was dark red in color. It was patent and without adhesions. The left tube and ovary were normal in size and appearance.

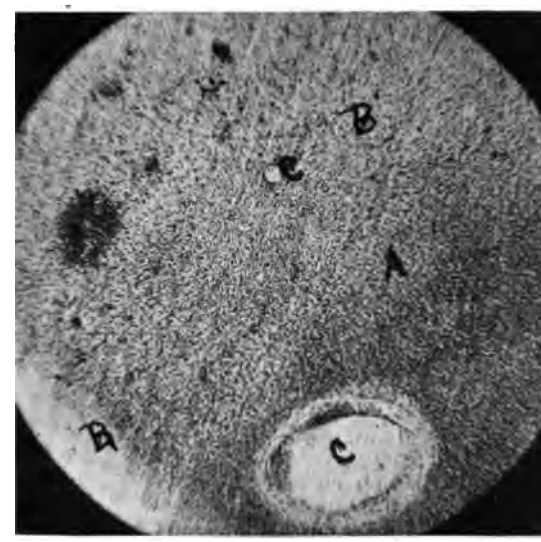



Fig. 4. Section from block C, Fig. 1: A, dense fibrous connective tissue; B, B, less dense connective tissue than at A, œdematous in appearance; C, blood-vessel.

*Microscopical examination.* Hæmatoxylin and eosin stains. Sections from different areas vary somewhat. From block A Fig. 1 (see Fig. 2) they show a reticular network of degenerated fibrous tissue with several dilated blood-spaces, the walls of which show no cellular structure. No staining cells are seen excepting a few scattered degenerating white blood-cells and small round cells in the meshes of the fibrous tissue and in the non-staining, homogenous, slightly granular débris filling the fibrous meshes.

Sections from block B Fig. 1 (see Fig. 3) show the firmer non-hæmorrhagic part. On the surface is seen a capsule of several layers of parallel connective-tissue fibers, with but few nuclei but with many free red blood-cells between the fibers. Deeper in the section the fibrous tissue is more compact, the bundles of parallel fibers interlacing and being cut at all angles. Here the nuclei are very much more in evidence, being so compact in places that little of the cell except the nucleus is seen. The nuclei are rounded or oval, occasionally slightly irregular, staining uniformly and evenly, though rather lightly. No mitotic figures or evidences of direct division are seen. The vascularity is not pronounced, though several large and

smaller vessels are seen. The cells are apparently connective-tissue cells, considerably hypertrophied and densely packed.

Sections from block C Fig. 1 (see Fig. 4) show much the same picture as those from block B, except that there are many irregular areas where the nuclei are more or less widely separated and the tissues appear somewhat œdematous. Scattered through the sections of blocks B and C are groups and masses of red blood-cells. Here and there is seen a white blood-cell or lymphoid cell filled with a granular brown pigment, originating most probably from degenerated red blood-cells.

Using Weigert's modification of Van Gieson's stain for differentiating, the fibrous tissue shows up very beautifully as red homogenous streaks and bands, and is seen to be the only constituent tissue present.

*Diagnosis.* Pure fibroma of the ovary.

In conclusion, I wish to thank Dr. Hunter Robb for the privilege of reporting his case.

## LITERATURE

1. Boivin, Mad. Treatise on Diseases of the Uterus. English Tr., 1834, ch. iv, 477.
2. Kiwisch. "Diseases of Women." About 1845.
3. Leopold. Die Soliden Eirestocksgeschwülste. Arch. f. Gynäk., vi, 189.
4. Coe, H. C. Am. J. Obst., N. Y., 1882, xv.
5. Henrolin, F. Internat. Text-Book Surg., 1900, ii, 650.
6. Cohen, Text-Book Gynec., Chas. S. L. Reed, 1901, 614.
7. Pfannenstiel, Ibid.
8. Coe, H. C. Loc. cit., p. 569.
9. Bland-Sutton. Keen's Surgery, i, 781.

# MIXED-CELL TUMORS OF THE SOFT PALATE

By MILTON G. STURGIS, M. D., Seattle, Washington

WHILE, in the cephalic region, the salivary glands are the most frequent site of mixed-cell tumors, yet they do occur in other portions. Wood, in his study of 59 cases, reports four from the lips, two from the pharynx, two from the neck, one from the cheek, and one from the palate just anterior to the folds of the soft palate, which recurred after removal, the recurrence extending into the soft palate. Verhoef also has reported five cases of mixed-cell tumor of the lachrymal gland.

A search of the literature discovers relatively few occurring in the soft palate, although the number arising from the hard palate is considerable. A number of cases have been reported in the French literature, where this topic seems to have been one of considerable interest.

*Etiology.* There has been much discussion as to the etiology of these. Adami inclines to class them as developing from embryonic pluri-potential cells. The German school believed them to be of endothelial origin, while the French school believed them to be of epithelial origin. J. B. Pitance concludes that these tumors are "not of glandular origin, but rather are the result of the proliferation of aberrant epithelial elements resulting from a process of invagination."

McCarty, in his study, concludes, in the seventh paragraph, that connective tissue and parenchymatous elements both tend to revert to embryonic type; in the next, that there is little evidence that these tumors arise from proliferating adult epithelium or endothelium; in the ninth, that there is considerable evidence to support the theory that these tumors are mesotheliomata of embryonic origin.

Wood's conclusions are as follows:

1. There is a group of extremely complicated tumors occurring in the facial region, which contain elements from both epiblast and mesoblast, in most intimate relationship to each other.

2. The complicated structure of the stroma, containing, as it does, such elements as embryonic connective tissue, cartilage, bone, fat, and lymphoid tissue, and, very rarely, striated muscle, is explained most easily by the assumption of an embryonic misplacement of mesoblast.

3. The structure of the parenchyma is so slightly characteristic in morphology that its epithelial nature in all cases can only be considered as probable; yet in about 24 per cent of the tumors examined the presence of epithelium is undoubted. The form and relationship of the cells of the parenchyma do not furnish sufficient data to justify us in regarding these cells as of epithelial origin.

4. The theory of early embryonic displacement of epiblastic tissue during the process of formation of the parotid and submaxillary gland and the brachial arches may account for many of the morphologic peculiarities of the cells of these tumors, especially the lack of any typical features which we associate with epithelium.

5. The same conditions may be seen in the epithelial cells of congenital moles, in which the epithelium is with difficulty distinguished from connective-tissue cells, owing to its close connection with the stroma of the tumors and its undifferentiated type.

The mixed tumors of the salivary gland run a clinical course, strikingly different from the sarcomata and carcinomata, in that they are slow-growing and generally are benign. The regional lymph-nodes are not invaded, and recurrences are likely to remain local in a considerable number of the cases.

The usual conclusion that these tumors occur only in young people seems not to be substantiated by the cases collected, one case occurring before the age of 20, four from 20 to 30, two from 30 to 40, two from 40 to 50, three from 50 to 60, one from 60 to 70, and one over 70; thus 50 per cent occurred after 40 and 35 per cent after 50. While these are the ages at the time of operation, yet, of those cases occurring after 40, 4 were stated to

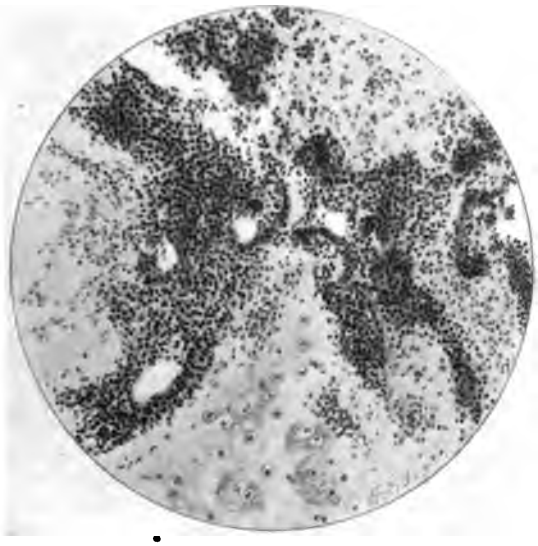


Plate 1. Tumor mass adjoining cartilage.

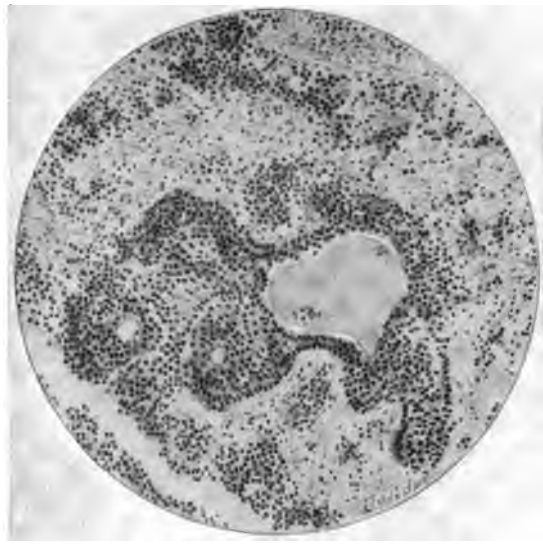


Plate 2. Mantle of cells around blood-vessels.

have begun at 43, 51, 52, 59, respectively. The three in which the duration of growth was not stated were reported at 41, 57, 55, and in the latter two it seems safe to assume that they did not begin until after 50. The duration of growth generally is two or three years; but it varies from a few months to twenty years in this series of cases, and depends upon, first, location; second, the rapidity of growth; and third, the susceptibility of the patient to the resultant discomforts, named in the order of their prominence — first, interference with phonation; second, deglutition; third, respiration.

They occur on either side of the palate in about the same proportion, but rarely in the middle. They vary in consistency according to the predominance of the epi- or endothelial, fibrous, chondromatous, or myxomatous elements. They are benign. In the 14 cases there is no mention of recurrence, of glandular involvements, or of metastases; but we must remember that the location of the tumor demands early operation if there be any considerable growth, and since this rapidity of growth seems in some cases to be largely due to the growth of the epithelial elements, as pointed out by Dr. West in his pathological report on Case 1, it would seem that the early removal had much to do with their benignity. Wood found in his series of parotid cases that 45 per cent of the cases he was able to trace recurred locally, and in 20 per cent of these recurrences there was evidence of internal metastasis.

In view of the occasional malignant degeneration of well-defined mixed-cell tumors due to the sudden "lighting-up" of activity in certain ones of the epi- or mesoblastic cells, it would appear not improbable that they might primarily develop into the hybrid carcinomata and sarcomata seen occasionally in the parotid and testicle.

Mrs. F. F. S., 28 years old. Family history negative. About two years ago she first noticed a small tumor, the size of a cherry, about midway in the right side of the soft palate. This has increased in size up to the present time. Examination shows a tumor about the size of a plum in the right side of the soft palate. Apparently, it is encapsulated and non-adherent, the mucous membrane moving freely over it. Under general anæsthesia it was easily removed; no hæmorrhage. There has been no recurrence after a lapse of two years. In view of the generally accepted opinion that these tumors arise from persistence of embryonic cells, it is interesting to note that this patient had also another developmental anomaly—a dydelphic uterus — two separate uterine cavities opening through a fused cervix into a single vagina.

*Pathological report* of Dr. O. J. West. Tumor is 3.5 x 2.5 x 2 cm. in size, encapsulated and nodular. The nodes are of softer consistency than the re-

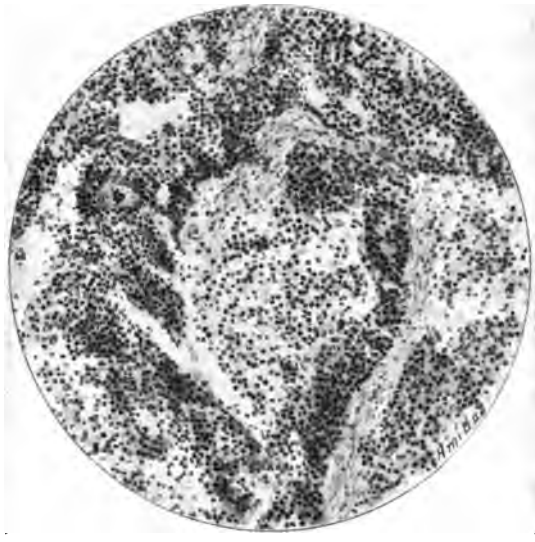


Plate 3. Matured portion of tumor.

mainder of the growth, giving the impression that they are "younger" and more rapid-growing than the other portions of the tumor.

On section, the tumor appears fibrous in character, but contains small islands of cartilage, and scattered through the growth are quite small, dark areas, apparently without stroma. These areas are most prominent in the nodular portions of the tumor where the appearance approaches that of a carcinoma.

*Microscopical appearance.* The major portion of the growth is composed of fibrous connective tissue, among which are occasional involuntary muscle fibers and quite large islands of cartilage (Plate 1).

Throughout the growth are areas and strands of deep-staining cells. These cells have a rounded nucleus, which varies in size from that of the lymphocyte to the large vesicular nucleus of the embryonic type of cell. In many places it can be determined that these cells surround the vessel lumen and follow its course (Plate 2). In places they are plainly invasive, this being most prominent in the nodular portions of the tumor (Plate 3).

The microscopical picture is that of an endothelioma. The location and character of this tumor led to the assumption that it arose from embryonic cell rest or inclusion, and the similarity between it and the "mixed-cell" tumors of parotid and testicle is pronounced.

1. McLeod reports a youth 20 years old; tumor in the soft palate; duration, ten months; growth, rapid. During the past three months he had great difficulty in talking, breathing, and swallowing. The tumor was not adherent. It lay between the two surfaces of the right side of the soft palate, displacing the uvula to the left, and bulging into the pharynx as far down as the tonsil, which was concealed by it.

2. Gross reports a female aged 25; tumor in right side of soft palate; duration four years. It increased slowly until it interfered with mastication and deglutition; for months it interfered considerably with speech. Examination of the mouth showed a large tumor taking in a large portion of the oral cavity, situated mostly on the right side but encroaching well over the median line. It was removed by enucleation. The tumor weighed 75 gm. and measured 7 x 5 x 4 cm., which showed it to be a "sarcome endopérithelial à trame myxochondrofibromateuse."

3. Mauclaire and Durrieux report a male 71 years old, with a tumor in the left side of soft palate; it reached to the raphé. Tumor was the size of a cherry; it began 20 years before, but had remained quiescent for many years. It was nonadherent, firm, quite smooth, and slightly lobulated. On microscopical examination it was called an epithelioma with fibrous stroma. Twenty years before, the patient noticed for the first time a slight enlargement in the mouth, which gradually increased in size for a while, and then remained stationary for years; it did not give rise to any pain or functional trouble, and did not affect the voice in any way.

4. Sébileau reports a female aged 15; location of tumor not noted. It was as large as a mandarin, and limited to the soft palate. It was enucleated without difficulty. The microscopical examination was not completed.

5. Von Gabourd's case was a female aged 55; a median tumor; duration unknown, although she had had dysphagia for two or three years. Increasing difficulty in deglutition caused her to go to the hospital. Examination of the throat showed the soft palate to be greatly depressed by a median rounded tumor, whose lower end touched the base of the tongue and caused the uvula to deviate to the right side. It was removed by cutting the pedicle.

After hæmorrhage had ceased, it was ascertained that the insertion of the tumor was on the superior surface of the soft palate, in the median line, near the point of insertion of the nasal fossæ. It measured 8 to 9 cm. and was long in volume, like a large thumb; fibrolipoma. On microscopical examina- the fibrous stroma was very dense, with spaces containing fatty tissue. The lining of the tumor was composed of several layers of keratinized cells. Underneath this, an infiltration of rounded cells agglomerated, similar to adenoid tissue.

6. Berger reports a female aged 30; tumor of the left half of the soft palate, causing deviation of the uvula; no disturbance whatever, except change in voice. The tumor was smooth, firm, and very hard; it was extirpated with difficulty because of existing adhesions. Microscopical examination showed there was a mixed tumor.

7. A male, 29 years old, had a mixed-cell tumor

of the parotid, which was removed. A year later he had a recurrence, at which time a mixed tumor was found in the right side of the soft palate. The tumor was large, slow-growing, uneven, lobular; the voice was nasal and rough; phonation and deglutition were interfered with. Tumor was removed by a long vertical incision in front of the mastoid process with great difficulty. Microscopical examination showed the encapsulated tumor containing both epithelial and connective tissue, the latter predominating.

8. A male, aged 41; he experienced no trouble except change of voice. The tumor covered the entire left half of the soft palate. Encapsulated, lobulated, mixed cell, in which the epithelial element predominated.

9. Heron reports a male, 57, with an enormous tumor in the right side of soft palate, encroaching on median line. No symptoms except dyspnœa. After admission to hospital, and prior to operation, he had a severe attack of dyspnœa, and died a few minutes later. The tumor, removed post-mortem, showed epithelial elements in small amounts and various forms of connective-tissue elements, mainly myxomatous and enchondromatous.

10. Swyngdaux reports a female aged 34; pain in throat; slow-growing tumor, which had been stationary about six months. The tumor is situated in the right pillar of soft palate. At operation, it was found firmly adherent. It weighed 30 gm. and was of myxomatous and cartilaginous cells and epithelial cells.

11. Escat's case was a female of 65; duration of tumor, many years. For past six years patient was conscious of a nut-sized lump in the soft palate. Phonation was affected; respiration difficult when reclining. A pear-shaped tumor was found in the buccopharyngeal isthmus, reaching to the epiglottis; it was removed with difficulty. Severe hæmorrhage. Microscopical examination showed tumor to be composed of epithelial and connective tissue.

12. Cuggenheim and Ripault's case was aged 44; size of tumor is unmentioned. For eight months had experienced sensation of weight in back of mouth, accompanied by strangling but no pain. Difficult deglutition. Tumor in the left half of soft palate. On microscopical examination it was called myxosarcoma, with fibrous formation and leucocytic infiltration.

13. Halstead's case was a male, 55, who had acute attacks of inflammation of the throat and some huskiness of voice, which was normal except at these intervals. Tumor was left-sided and subtonsillar, the swelling being greatest in the soft palate above the arch. It had been known for the past 20 years. Removed by Hist. The tumor was 7 cm. long and consisted of connective tissue, in which are areas filled with epithelial cells; the connective tissue loose, with a tendency here and there to cartilaginous or mucoid tissue; some hyaline degeneration; some areas infiltrated with lymphoid and plasma cells.

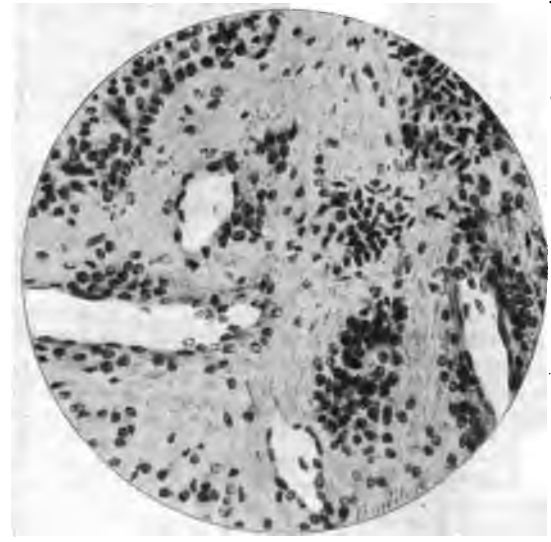


Plate 4. Showing the proliferation of tumor-cells around the blood-vessels.

## REFERENCES


1. McLeod, K. Fibromyxoma of soft palate and right fauces; removal by external incision and enucleation; recovery; remarks. Lancet, Lond., 1889, i, 732.
2. Gross and Hoche, G. Tumeur mixte de voile du palais (Mixed tumor of soft palate). Rev. méd. de l'est, Par. & Nancy, 1902, xxxiv, No. 21.
3. Mauclaire and Durrieux. Tumeur mixte du voile du palais. Bull. Soc. anat. de Par., 1897, lxxii, 609.
4. Sébileau, Pierre. Tumeur mixte du voile du palais. Bull. et mém. Soc. de chir. de Par., 1903, xxix, 890.
5. Gabourd, Th. Fibrolipoma median de la face supérieure du voile du palais. Gaz. d. hôp., Par., 1906, lxxvi, 1299.
6. Berger. Tumeurs mixte du voile du palais. Rev. de chir., Par., 1897, xvii, 361.
9. Heron. Adenochondrome voluminoux du voile du palais; mort par asphyxie. (Adenochondroma of the soft palate; death from asphyxia). Gaz. de hôp., Par., 1888, lxi, 650.
10. Swyngdaux. Tumeur mixte du voile du palais. L'echo méd. du nord, 1912, vi, 102.
11. Escat, E. Adenome du voile du palais. Arch. prov. de chir., Par., 1897, vi, 320.
12. Pitance, J. B. Étude sur les tumeurs mixte du voile du palais. Thèsis, Paris, 1897, 127 pp. Reports cases by Cuneo and Durrieux, 3 cases by Berger, 1 case by Escat, and a case by Guggenheim and Ripault (Ann. d. mal. de l'oreille et du larynx, 1890).
13. Halstead. Laryngoscope, xvi, 697.

# THE ASCENDING INFECTION OF THE KIDNEYS

By J. E. SWEET, M.D., PHILADELPHIA
Assistant Professor of Surgical Research, University of Pennsylvania
AND
L. F. STEWART, M.D., PHILADELPHIA
Resident Pathologist, Pennsylvania Hospital
From the Laboratory of Surgical Research, University of Pennsylvania, and the Ayer Clinical Laboratory of the Pennsylvania Hospital

IN a paper published from this laboratory, Steinke (1) reviewed the literature, both clinical and experimental, of the operations which have been performed for the anastomosis of the ureters with the intestinal tract, and concluded that the problem is one of physiological and surgical mechanics, and as such should be open to solution. It is evident from this review that general peritonitis, ascending infection of the kidneys, and cicatricial contraction of the opening into the bowel are the three difficulties which oppose themselves, in the order given, to the success of the operation, and that of these three difficulties the ascending infection of the kidney is of the greatest importance. Before this ascending infection can be prevented, we must have a clear knowledge of the pathway by which it reaches the kidney; for if the infection proceeds through the lumen of the ureter, some valve construction comparable to that valve action of the normal ureteral orifice must be devised. This has been more or less successfully accomplished — less by such a method as that devised by Coffey, more by the transplantation of the ureteral orifice itself or the entire trigonum, as in the operation devised by Maydl. But if the infection travels by way of the blood-vessels of the ureter, which is highly improbable, or by the lymphatics, the surgical difficulties to be overcome assume an entirely different nature from the mechanical problem of a valve construction to protect the lumen of the ureter.

The problem of ascending infection of the kidney, therefore, becomes the fundamental problem to the operation of the successful anastomosis of the ureters with the bowel; but the common clinical occurrence of a spontaneous ascending infection of the kidney demands also its true explanation, and the rapid development of the method of cystoscopic examination of the bladder and ureters demands a clear understanding of the truth, so that the specialist may take the proper measures to prevent the accident of an ascending infection following his manipulations. If the infection travels upward through the ureteral lumen he must turn his attention to faultless technique, or even refrain from ureteral catheterization in the presence of a cystitis; while if the lymphatic system is at fault, his attention must be directed toward the existing ulcerations of the mucosa and toward the scrupulous prevention of any instrumental injury or tearing of the mucosa. It might further be advisable for the cystoscopist to direct his attention to the treatment of the ulcerations of the bladder mucosa, rather than to be content with the treatment of the general cystitis.

In Steinke's paper the suspicion was raised that the pathway along which the infection ascends is the lymphatic system of the ureter and kidney. A second paper from this laboratory by Stewart (2) records the results of a specific study of the question of ascending infection. By using sections of small arteries hardened in formalin (Fig. 1), he succeeded in producing an unusual pathological condition — an ascending infection which was primarily a paranephritis, with a secondary general involvement of the kidney. In the early stages the picture was that of a pure paranephritic infection; the late stages showed the usual picture of ascending infection. The peculiar picture seen in these cases could only be explained by assuming that the infection had traveled upward through the lymphatics of the ureter; and the conclusions, among others, were that "ascending infection of the kidney quite often takes place through either the lymph- or the blood-vessels of the ureter. When infection takes place in this way, it seems almost positive that the lymph-

vessels of the ureters are the carriers of the infection." "The lumen of the ureter is less often a factor in ascending infection of the kidney than has previously been supposed." "In these experiments, the virulence of the infection rather than its duration determined its extent; in no case did time seem to bear any relation to the extent of the infection."

The suggestion was advanced in this paper that one of the chief difficulties met in the transplantation of the ureters is offered by the infectious ulceration of the lips of the intestinal wound; bacteria, ordinarily not especially virulent in the intestinal content, become virulent when growing on this ulcerated surface, with the result that the end of the ureter dips into a virulent colony of pus-producing micro-organisms.

Coincident with Stewart's paper appeared the first article by Bauereisen (3) regarding experimental work on the question of ascending infection, and using the tubercle bacillus as an infecting agent. This work led to the following interesting conclusions: First, a bladder with intact mucosa cannot be infected with tubercle bacilli; second, if the flow of urine is not hindered, tubercle bacilli present in the bladder cannot reach the kidney pelvis intra-ureterally; third, stoppage of the flow of urine by marked stenosis or by obliteration of the lumen of the ureter will, as a rule, result in an urogenous ascending tuberculosis of the kidney; fourth, an extensive tubercular cystitis is carried first into the wall (adventitia, muscularis, submucosa, and, finally, mucosa) of the lower segment of the ureter, and wanders gradually in the external layer toward the kidney.

The justification for such conclusions rests finally upon the demonstration in normal tissues of a network of lymph-channels which should be anatomically capable of taking up and transmitting an infection from one part of the urinary tract to another part. Such a network should also be demonstrable in the mucosa and the submucosa.

Mascagni, in 1787, showed that the lymph-vessels of the upper ureter went into the kidney, and those of the lower ureter went into the lateral lymph-nodes of the anatomical pelvis, but the earlier information on the

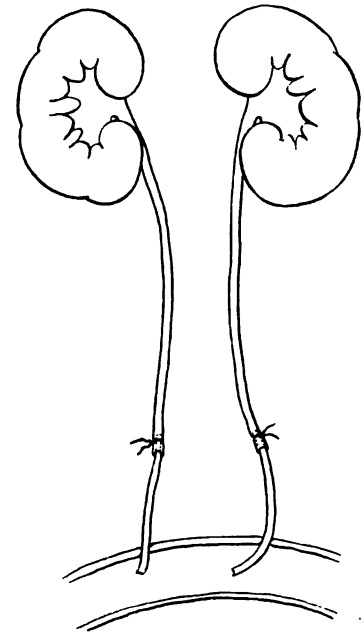


Fig. 1.

lymphatics of the ureter is meager and contradictory. References to this earlier literature will be found in the work of Sakata (4), whose findings are as follows:

1. No network of lymph-vessels is demonstrable in the mucosa and submucosa of the ureter — at least, not by means of Gerota's injection method.

2. On the other hand, there are, in the muscle sheath and on the external surface of the ureter, well-developed lymph-vessels which, for the most part, lie parallel with the blood-vessels.

3. The afferent lymph-vessels are present chiefly in the central or middle portion of the ureter and go to the lumbar glands, which lie both beside and anterior to the aorta and the vena cava and internal to the common iliac artery.

4. The lymph-vessels of the lower section of the ureter go either directly into the hypogastric glands or else they unite with the lymph-vessels of the bladder.

5. In the upper section, the lymph-vessels which go directly into glands are not constantly demonstrable, but in case they are demonstrable they go to the glands, which lie far above, beside, and over the ureter.

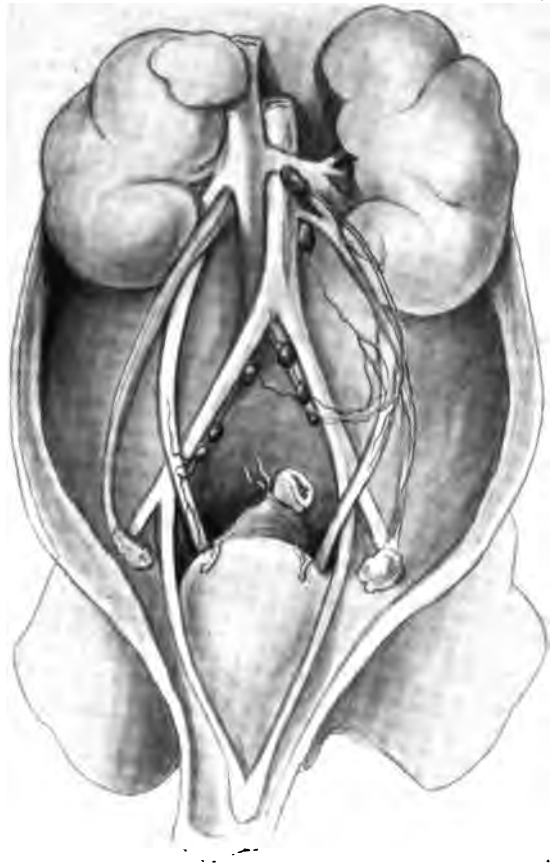


Fig. 2.

Otherwise, they pass into the lymph-vessels of the kidney.

6. The lymphatic unions between the bladder and kidney are not direct, but exist either by the interposition of the regional glands of the bladder and kidney or by means of the lymph-vessels of the ureter.

The vessels of the ureter communicate with the vessels of the kidney and bladder. There are two ways of indirect communication: (1) By way of the hypogastric lymph-glands (from the kidney to the lumbar glands and from the bladder to the hypogastric glands, and the lumbar and hypogastric glands communicate); (2) the lymph-vessels of the ureter communicate at the upper and lower parts of the ureter with the vessels of the kidney and bladder.

The vessels of the lower ureter go to regional glands; the bladder lymphatics go to regional glands; but these vessels may anastomose before reaching the hypogastric glands.

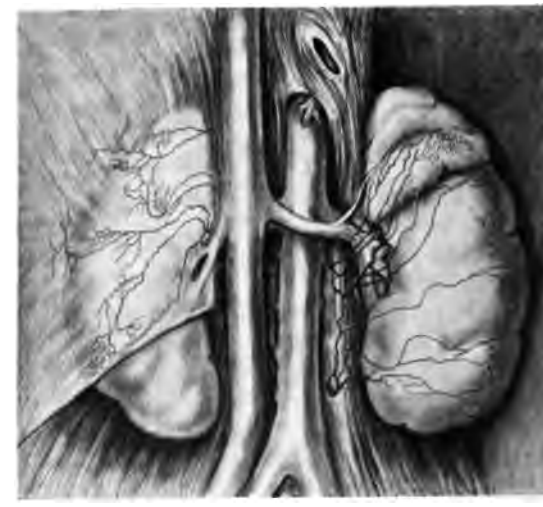


Fig. 3.

From the lower ureter the lymph-vessels of the lower portion of the ureter can be filled. The single lymph-vessels that run lengthwise along the ureter unite with the lymphatics of the kidney and the pelvis of the kidney. Gerota has shown a direct passage of lymphatics of the ureter into those of the bladder.

The lymph-vessels are so situated and connected that they offer a favorable means of transmitting infection from the bladder to the kidney, especially since they are capable not only of transmitting infection through the walls of the ureter, but also through the regional glands, which act as connecting links between the lymphatics of the bladder, ureter, and kidney. The accompanying plate (Fig. 2) is reproduced to show the relations of the lymph-channels described by Sakata to the regional glands of the pelvis and the kidney. It is interesting to note that the lymphatics which leave the ureter to go to the regional glands are in connection with the kidney through these glands, while the veins which leave the ureter go, as a rule, to the veins which empty into the general circulation without reaching the kidney.

Lymphatic infection of the kidney is favored also by the tendency of the lymphatic currents of the ureter to flow upward.

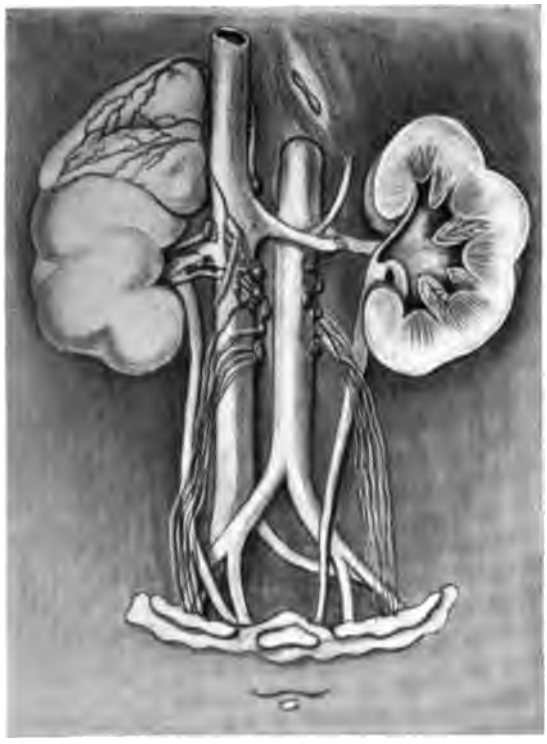


Fig. 4.

Kumita (5) demonstrated superficial and deep lymphatics in the adipose capsule. The superficial lymphatics form a capillary network which drains into a lymph-node lying above the renal vein of the corresponding side (Fig. 3). On both sides these lymphatics are connected with those of the diaphragm, and on the right side they are also connected with those of the liver. The deep lymphatics form a similar network, and terminate on the right side in a node lying below the exit of the renal vein and to the left of the vena cava. On the left side they empty into a node lying below the renal vein and to the left of the aorta (Figs. 3 and 4).

These deep lymphatics communicate with the superficial lymphatics and those of the fibrous capsule.

In the dog the external layer of the fibrous capsule has a capillary network of lymphatics communicating with the deep lymphatics of the adipose capsule and the lymphatics of the internal layer of the capsule. The latter has a capillary network of lymph-vessels, which

Fig. 5.

communicate with those of the external layer of the capsule and empty into the lymphatics of the cortex of the kidney.

In the human being, a similar communication takes place between the lymphatics of the adipose capsule and those of the kidney. Lymph-spaces which communicate with the capsule of the kidney are found under the capsule.

The lymphatics pass from the cortex to Bowman's capsule, form a capillary network in the glomeruli, and from here pass along the loops of Henle and the collecting tubules, surrounding them as they go. They make their exits at the hilum, going to the regional glands. The lymphatics of the ovary empty directly into the lymph-nodes at the kidney (Fig. 4).

References to the work of others on the lymphatics of the kidneys will be found in the work of Kumita. Figs. 3 and 4 are from Kumita's work, and are reproduced here to point out to the thinking surgeon the intimate relationships between the lymph system of the entire abdominal cavity and that of the kidney. Let us, therefore, not conclude that a paranephritic abscess is "hæmatogenous" until the possibility of a primary focus in gall-bladder or appendix or somewhere in the pelvis has been ruled out.

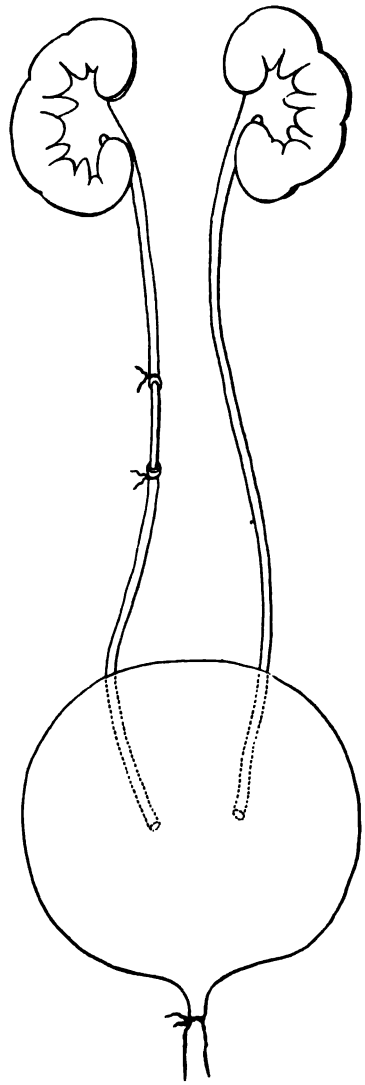


Fig. 6.

It will be noted that neither Sakata nor Kumita, whose work represents the best we have to their time, were able to demonstrate mucous and submucous channels. Bauereisen (6) undertook this study, and succeeded in demonstrating a rich network of lymphatics, as seen in the accompanying reproduction of one of his plates (Fig. 5). There seems, therefore, no reason for disagreeing with Bauereisen, that "the kidneys and the bladder, therefore, stand in much closer relation to one another through the lymphatics of the ureter than one has heretofore supposed. I think I may declare that the kidney can be reached from the bladder by pathogenic organisms more easily by way of the lymphatics than intra-ureterally." No exception can be taken to his final paragraph: "We are far removed from the view that every pyelitis and pyelonephritis is of lymphogenic origin, but we do believe from the final demonstration that the mucosa, submucosa, muscularis, and adventitia of the human ureter are provided with a great connected lymphatic network, that we have placed in the right light a previously hardly even mentioned path for the infection of the kidney, ureter, and bladder. We are convinced that the intra-ureteral path for an infection of the kidney by any pathogenic organism whatever, instead of the lymphatic path, has been overestimated. Certain cases of disease of the urinary tract can only be explained by the extension by way of the lymphatics. Even the hæmatogenous path for many cases must be excluded in favor of the lymphatic extension."

Bauereisen's injections did not bring out the network over long segments of the ureter, but are clearly seen in the cross sections of the tissue. If we now mentally add to the accompanying plates from Kumita's work (Figs. 3 and 4) an extended, intercommunicating network in the mucosa and submucosa, the possibility of the extension of infection along the lymphatics needs no further demonstration to the surgeon familiar with the rôle of the lymphatic system in other parts of the body in the spread of infectious processes; it is to be regretted that our knowledge of the physiology of the lymph apparatus, its purpose, the direction of the flow of the lymph, and so forth, is not equally clear.

The anatomical demonstration of the existence of the lymphatics being thus offered, the definite demonstration that this system is indeed most concerned, and that the intra-ureteral pathway for the ascent of the infection should be given up, can be accomplished in two ways — by the study of the pathological anatomy and by the direct experimental proof. Sugimura (7) has followed the former method in a paper published since the ap-

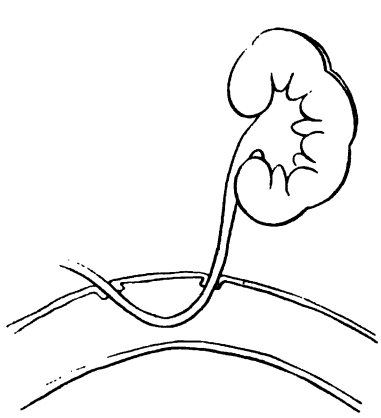


Fig. 7.

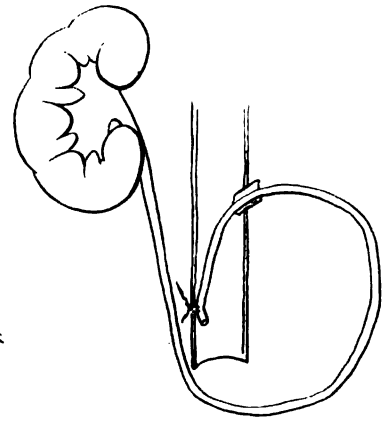


Fig. 8.

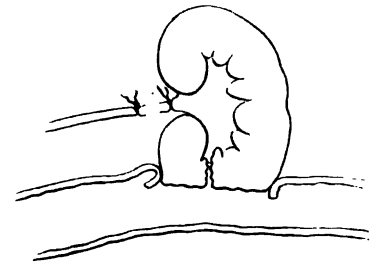


Fig. 9.

pearance of Stewart's work, drawing the following conclusions from a study of the material from 21 autopsies:

First: The ureters, especially the lower third, including the intramural portion, are almost constantly more or less involved in acute cystitis, with apparently unchanged ureteral orifices, by way of the lymphatics of the ureter.

Second: At the same time, one can find only traces of inflammation on the mucosa of the ureters; no continuous ascent of infection on the mucosa from the ureteral orifices can be demonstrated. This agrees with the already known fact that the ureteral mucosa is oftimes very little involved in simple ascending infection of the upper urinary tract.

Third: It is remarkable that in acute cystitis many areas of infiltration appear in the lower segment of the ureter in the lymph tracts of the muscularis and adventitia, and also of the submucosa. They are in the intramural portion of the ureter in relation with the lymphatics of the neighboring muscular coat of the bladder, and further with the lymphatics of the corresponding bladder mucosa. From this fact it may be concluded that the acute cystitis as such does not remain limited to the bladder wall, but ascends more or less toward the kidney through the lymphatics of the ureter.

Fourth: The ascent of the acute inflammation of the bladder through the lymphatics of the ureter toward the kidneys, which has up to this time never been described, seems to differ according to the kind and virulence of the organism producing the inflammation, the duration of the disease, and the anatomical change of the bladder wall. It seems probable to me that the ascent goes about parallel to the anatomical change of the inflamed bladder wall.

Fifth: Also in the chronic, non-specific inflammation of the bladder, with or without retention of urine, and also in the so-called simple descending infection of the upper urinary tract, the involvement of the lymphatics of the ureters can be clearly demonstrated. Although the mucosa of the ureter seems more extensively involved in the acute descending infection, the suspicion nevertheless lies close at hand that the lymph tracts of the ureter play an important rôle in the extension of the acute inflammation of the bladder and kidneys.

Sixth: The inflammation can further, with intact ureter, spring from the bladder to the kidney pelvis intra-ureterally, as has been described before.

We are inclined to accept Sugimura's findings, with the exception of the statement in his fourth conclusion that no one has described this lymphatic extension of the infection before him; and concerning his last conclusion we shall present evidence which would seem to throw doubt upon the likelihood of infection entering the kidney through the intact mucosa of the kidney pelvis.

Our own work has been conducted chiefly along the lines of the experimental method,

using the technique of pathological study in suitable cases. We have, from the nature of our problem, had constantly in mind the possibility of the successful anastomosis of the ureters with the bowel, and have in this way often obtained results of extreme interest to the fundamental question of the rôle of the lymphatics. Our work has been directed toward the condition so common in surgical practice, of the involvement of the trigonum and the intramural portion of the ureter, and therefore all of our experiments have been made with the object of anastomosing the ureter itself with the bowel.

That the infection can be demonstrated in the lymphatics is shown by the following line of experimentation, similar to that adopted by Bauereisen and Sugimura, of which the following experiment may serve as an example:

CASE 43, December 30, 1912. Both ureters were isolated for a short distance in their mid-portions, and anastomosed with the sigmoid by passing each ureter through a needle puncture of the mucosa, and fastening them in place by suturing the adventitious tissue of the ureter to the muscularis and serous coat of the bowel. January 7, 1913, the dog died. The ureters within the lumen of the intestine were gangrenous in appearance, quite large, and seemed to be covered with a membrane. Above this the ureters appeared normal, though they were constricted at the point where they entered the bowel. The pelvis of both kidneys was covered with a thin bloody membrane.

*Microscopic examination* of the left ureter and kidney: S, 32070, 20. Left ureter, portion lying within the lumen of the bowel. The mucosa and submucosa are normal; the muscular coat shows some engorgement of blood sinuses; the adventitious tissue is necrotic and infiltrated with many pus cells in its peripheral portion. This process subsides as the muscularis is approached.

No. 6. Left ureter near where it enters the gut. The mucosa is normal. In several areas beneath the mucosa there is an increase in submucous cellular elements. The submucosa shows some engorgement of its blood sinuses. The muscularis is normal. Beyond it are several small focal collections of pus cells. In the periureteral tissue are collections of pus cells, with accompanying congestion of the blood-vessels.

No. 7. Left ureter midway between kidney and intestine. The lumen contains some pus; the mucosa is normal and submucosa is in one area infiltrated with pus cells, small round and spindle cells. The muscularis beneath this shows less infiltration but vascular engorgement in addition. Most of the vessels of the adventitia show thrombosis. Periureteral tissue is that described in No. 6.

No. 15. Ureter at pelvis, kidney sinus, and adjacent kidney. The lower portion of the ureter is normal; the periureteral tissues show necrotic areas infiltrated with pus cells. Aside from this the tissue is fairly generally infiltrated with pus cells. As the kidney capsule is approached from this region, vascular thrombosis is evident and the infiltration with pus cells is less marked. This infiltration, however, extends into the cortical tissue of the kidney. The periureteral infiltration becomes much less marked as the ureter is ascended, but a bit higher there is marked necrosis of the ureter and infiltration with pus cells with involvement of the mucosa at this point and pus in the lumen of the ureter. This process extends into the alveolar tissue of the kidney sinus.

Such an experiment leaves no doubt that the micro-organisms are in the lymph-spaces, but the presence of pus in the lumen of the ureter makes it appear possible that the infection has broken into the lymph-spaces from the lumen of the ureter. Suppose then that we break the continuity of the lymphatic system but leave the channel of the ureter free and even, for an extent, held open as in the following experiment.

CASE 10, October 19, 1911. The mid-portion of the right ureter was isolated and 3½ cm. excised (Fig. 6). A piece of rubber tubing of approximately the same size as the ureter substituted, by telescoping it into the two ends of the ureter and fastening the ureter to the tube. The urethra was exposed, ligated in two places, and severed. A bouillon culture of virulent colon bacilli was then injected into the bladder. Death occurred in 48 hours. Autopsy shows some pelvic peritonitis and the peritoneal surface of the bladder was markedly inflamed. The left kidney was much larger than its fellow; its cortex showed hæmorrhagic areas, and the ureter was markedly inflamed. There were signs of inflammation of the right ureter from the bladder to the region of the rubber tubing. The right kidney appeared normal.

It will be noted that a motile organism was used and urinary retention produced, yet the infection on the operated side apparently extended only so far as the lymphatic system was intact. It is evident that the duration of the condition would have a bearing upon this experiment. Had the animal lived longer, the infection might have traveled along the outside of the rubber tubing and have entered the lymphatics above the tubing. Nevertheless, this fortunate experiment

showed that the infection of the bladder with motile organisms and in the presence of urinary retention does not travel upward through the lumen of the ureter. Suppose now this experiment be reversed — the ureter is placed in contact with infectious agents which cannot enter the lumen of the ureter, and we find the usual picture of an ascending infection, results departing in no way from the picture seen after transplanting the open end of the ureter into the bowel.

The following may serve as an example of this line of experimentation, and the result was the same in three other experiments. In one experiment the kidneys showed no infection.

CASE 4, December 7, 1910. Both ureters were freed from the surrounding tissue for the greater part of their course and dropped into the lumen of the sigmoid through separate incisions, 4 to 6 cm. in length (Fig. 7). The bowel was closed carefully over the ureter, and care was taken that the ureter should not be unnecessarily constricted at the points of entrance into and exit from the bowel. The normal course of the ureter to the bladder was not otherwise disturbed, and the urine followed its normal path into the bladder. Death occurred December 27th. Autopsy showed the incisions into the bowel to be nicely healed, and the intra-intestinal portion of the ureter intact, although much enlarged; both kidneys showed hydronephrosis and pyonephrosis, the usual picture of ascending infection. Three other cases showed entirely similar results; one case showed no sign of infection of the kidney.

In this case it is evident that the infection must have reached the kidney through some other channel than the lumen of the ureter, unless, of course, it might be supposed that the infection had traveled through the ureter into its lumen in the intra-intestinal portion of the ureter; but the normal appearance of the mucosa of this intra-intestinal portion of the ureter excludes this assumption.

That the infection does not proceed by way of the lumen of the ureter is also proven by the following experiment, which also proves our contention that the actual source of the infection lies in the infected wound of the bowel wall. The bacteria, which are not especially virulent in the intestinal content, become virulent when growing on the cut edge of the bowel, and thence pass into the lymphatics.

Before recording the following experiment, the conclusion reached by Stewart in his earlier paper should be recalled, that "the level at which the anastomosis is made has no influence on the resultant infection. In this series of experiments anastomosis was made at several levels, from the duodenum to the sigmoid, without change in the results."

CASE 40, December 10, 1912. The right ureter was isolated and severed close to the bladder and the free upper end passed through the lumen of the greater pancreatic duct into the bowel (Fig. 8). The left kidney was removed. Autopsy, December 23d, showed good healing at the site of entrance of the ureter into the duodenum. There were no signs of hydronephrosis or hydro-ureter, nor were there any signs of infection of the kidney.

Microscopic sections of the right kidney showed much engorgement of its blood-channels, but no evidence of infection.

Seven cases similar to this were done; in some, nephrectomy of the left kidney was done at a later date; in one, the pancreatic duct was transplanted into the appendix, and the ureter was passed through it at a later date. In none of these seven cases was there evidence of infection of the kidney. In some there was distinct evidence of obstruction, and in all of them death resulted. This operation is made possible in the dog by the fact that the dog possesses at least two pancreatic ducts, both of which are separate from the bile duct.

In these experiments, we see that even in the presence of obstruction to urinary flow, with the lumen of the ureter opening into an infected cavity, no ascending infection occurs if the lymphatic channels are not in contact with virulent organisms. It might be objected that, since the content of the duodenum is not particularly virulent, no infection resulted, and therefore the lumen of the ureter cannot be excluded as a pathway.

Any final belief that the infection really proceeds upward by any other path than the lymphatics must be forsaken in view of the following experiment:

CASE 46, January 14, 1913. The right kidney was exposed, and its ureter ligated in two places near the pelvis of the kidney and cut between; the lower pole of the kidney was then incised until the pelvis of the kidney was reached (Fig. 9). Hæmorrhage was controlled by radial sutures passed through the opening into the pelvis to the circumference of the

cut edge of the kidney. The duodenum was then opened and anastomosed with the kidney at the site of the opening into the kidney pelvis, by inverting the cut edges of the duodenum and fastening its serosa to the capsule of the kidney with fine Lembert sutures.

February 11th, the animal was in good condition, and was killed with gas. At autopsy, the left kidney and peritoneal cavity appeared normal; the right kidney was covered with omentum and showed duodenum attached. The right kidney and intestine were opened; the kidney appeared as normal as its fellow, except that the pelvis mucosa was covered with dirty mucus. Microscopic examination of the right kidney showed some small abscesses between the lower pole and the gut, with some necrosis and reactionary infiltration in the lower pole. In isolated areas confined to the lower pole of the kidney were areas of cellular infiltration; the mucosa of the pelvis was generally free from infection, though in areas there was submucous infiltration with small round and epithelial cells. The upper pole of the kidney is not involved.

Eleven operations similar to this were done, various segments of the intestine from the duodenum to the sigmoid being chosen as the site of the anastomosis. In two instances both kidneys were treated the same way. In but one of all these operations was the resulting kidney infection general. In those in which the opposite kidney had been removed, the kidney which had been anastomosed with the intestine showed at autopsy compensatory hypertrophy. The mucosa of this kidney appeared perfectly normal, even in one instance where there was a slight hydronephrosis. If, however, the opening into the bowel closes later, as has happened in several instances in which the opposite kidney had been left intact, and which are not included in these eleven cases, a general kidney involvement may occur. That this should occur seems self-evident, since an infection enclosed in any body cavity will naturally spread. This condition is entirely comparable to Bauereisen's results, where general renal tuberculosis followed marked stenosis or complete obstruction of the ureter.

In regard to the ascending hæmatogenous infection, Stewart concluded that, though infection of the kidney would seem to be possible through the ureteral blood-vessels, it must be decidedly rare, since the veins of the ureter tend to empty into the neighboring veins rather than to drain toward the kidney. Should the veins of the ureter happen to carry infection toward the kidney, the venous flow coming from the kidney would tend to withhold the kidney infection from the ureteral veins that empty into the kidney veins. However, progressive venous thrombosis would permit infection to reach the kidney.

Our further consideration of the subject of hæmatogenous kidney infection during our work since the publication of Stewart's paper leads us to a still more decided conviction that the theory of the hæmatogenous infection of the kidney through the veins of the ureter does not explain the acute infections following the transplantation of the ureter into the intestine. While the facts so familiar to the experimental bacteriologist, of the results following inoculations into the blood-stream of organisms of low virulence, prove that strictly localized infections can follow such inoculations, and, therefore, prove the possibility of hæmatogenous kidney infection from foci outside the genito-urinary tract, we still hold that the spread of the infection, once entered the genito-urinary tract, is entirely lymphatic. Our suspicion is, furthermore, very strong that the post-operative infections of the kidney, such as those described in the recent paper by Furniss (8), are likewise transmitted by the lymph system to the kidney.

It might seem to make little difference in a practical way whether the infection had proceeded to the kidney by way of the blood-stream or by way of the lymph-stream; the misfortune has occurred, and the kidney must be treated. Indeed, if we hold to the hæmatogenous theory, such treatment is all we can do. But if we are to conclude that the infection is lymphogenic, then we must find the primary focus and treat that as well as the kidney lesion.

From the anatomical, pathological, and experimental evidence offered in the foregoing pages, it would seem justifiable to conclude:

1. That an extensive network of lymph-vessels and channels exists in the mucosa and submucosa, in the external coats of the bladder and the ureters, and in the entire structure of the kidney. This network in the

ureter anastomoses freely with the lymphatics of the bladder at the one end, and with the lymph apparatus of the kidney at the other end.

2. That an ascending infection travels through this lymphatic system, not through the blood-vessels of the ureter nor through the lumen of the ureter. (*a*) The blood-vessels can be excluded, because the veins of the bladder and the veins of the ureter, for the greater part, open into the general venous system, not into the venous system of the kidney. (*b*) The lumen of the ureter can be excluded, because if the lumen be open to infection, the infectious process is traceable in the lymphatic system, not along the mucosa of the ureter. If the lumen be closed to infection, the process extends to the kidney in the usual way; if the lumen be open to infection, but the lymphatics not in contact with virulent infection, as when the ureter is passed through the pancreatic duct, there is no ascending infection; if the lumen be open, but the continuity of the lymphatics be interrupted, infection does not ascend; and finally, if the kidney pelvis be directly connected with the gut, the general infection, characteristic of an ascending infection of the kidney, does not occur.

From the point of view of the practical surgeon, it would seem that these results would be of service in the consideration of the possibilities of any infectious process involving the lower genito-urinary tract or the pelvic organs in general; certainly the cystoscopist must transfer his attention from the general question of cystitis to the particular one of the local lesions caused by the cystitis, their extent and location. The possibility of the effective local treatment of ulcerated processes of the bladder is also suggestive.

The results of this work upon the general question of the anastomosis of the ureters with the bowel would not seem to hold out much promise. In our hands, at least, every attempt thus far has been blocked by the ease and rapidity with which the infection enters the lymphatic system of the ureter.

BIBLIOGRAPHY

1. STEINKE, CARL R. Transplantation of the Ureters into the Gastro-intestinal Tract. Univ. Penn. Med. Bull., 1909, June.
2. STEWART, L. F. A Study of Ascending Infection of the Kidney, etc. Univ. Penn. Med. Bull., 1910, July-August.
3. BAUEREISEN, A. Beitrag zur Frage der aszendierenden Nierentuberculose. Ztschr. f. gynäk. Urol., 1910, ii, 132.
4. SAKATA. Über den Lymphapparat des Harnleiters. Arch. f. Anat. u. Physiol., Anat. Abt., 1903, 1.
5. KUMITA. Lymphgefässe der Nieren- und Nebennierenkapsel. Arch. f. Anat. u. Physiol., Anat. Abt., 1909, 49.
Über die Lymphbahnen des Nierenparchyms. Arch. f. Anat. u. Physiol., Anat. Abt., 1909, 94.
6. BAUEREISEN, A. Über die Lymphgefässe des menschlichen Ureters. Ztschr. f. gynäk. Urol., 1911, ii, 235.
7. SUGIMURA, S. Über die Beiteiligung der Ureteren an den akuten Blasenentzündungen, etc. Virchow's Arch. f. pathol. Anat., etc., 1911, xx, 206.
8. FURNISS, H. D. Post-operative Renal Infection. J. Am. M. Ass., 1913, lxi, 957.

# DENTAL DISORDERS AND PERIDENTAL INFECTIONS: THEIR RELATION TO NEIGHBORING ORGANS[1]

By V. P. BLAIR, A. M., M. D., F. A. C. S., Saint Louis

As "Necessity is the mother of invention," so also is it the chief stimulus to association. It is the somewhat tardy general recognition of the interdependence of dental and general pathology that bids fair to be the link that will restore dentistry to its proper relation to general medicine, from which it was formerly divorced in the founding of the first independent dental college in Baltimore in 1839 (33). While this separation has undoubtedly been a great stimulus to the development of mechanical dentistry, it has none the less been responsible for the fact that in the treating of the teeth great technical skill is often exercised without due regard to the extent and exact nature of the lesion. The most perfect filling of the roots of a devitalized tooth will, in many instances, but serve to hide pre-existing damage to the peridental tissues.

It is now recognized that the clinical manifestations of disease that we classify are in most cases the direct or indirect results of infections that gained entrance to or were harbored in some particular organ or part of the body. Next to prophylaxis, the most perfect form of medical practice is that which seeks to eliminate disease before it has done more than purely local damage. In pursuance of this, the appendix, the urethra, the kidneys, the skin, and the tonsils have been recognized as important primary or intermediary foci of infection.

But while it has long been known that the mouth is the most prolific of all, still it is only somewhat lately that oral sepsis began to receive the attention that it deserves (81, 82). Exclusive of the tonsils, it is the teeth and their immediate root coverings that here furnish the great atria of infection that menace every tissue and structure in the body. In this connection there are three distinct routes by which infection may enter: through the open pulp canal, through a diseased peridental membrane, and through injuries to surrounding tissues (the cheeks or tongue) by the sharp edges of carious crowns and roots (17, 72). Except in older people, where chronic mechanical irritation by a jagged stump may be followed by cancer, the latter injuries are comparatively negligible.

In infection and gradual destruction of the peridental membrane, and with it a partial necrosis of the alveolar bone, we have the much exploited "pyorrhœa alveolaris." A destruction of the peridental membrane of all of the teeth to a depth of one-eighth inch from the gingival border will leave an exposed, chronically suppurating surface of from two and one-half to three square inches (39), from which not only are toxins absorbed by the granulations but most of the exuding pus is swallowed. Judged from its dire results, the most important of all is the infection of periapical tissues resulting from dental caries. Pyorrhœa alveolaris in an advanced form is not a common affection, and is limited almost exclusively to adult life, while dental caries is the most common affliction of civilized races, hardly five per cent being exempt. Being common in the youngest children, it exposes their tissues to direct and continuous infection, while their acquired immunities are nil or are very feeble.

After a caries has penetrated into the pulp chamber, there is an open avenue to the vascular tissues about the apex of the tooth, and thence through the blood and lymph streams, and possibly the nerves, to all of the body tissues. Pathogenic organisms lodged and incubating within the pulp chamber and root canals may thus be disseminated. If through this source there occurs a low grade septic infection of the periapical tissues, this may be followed by a gradual absorption of bone in the immediate neighborhood, giving rise to a chronic bone abscess. This may persist for years, causing few or no evident local symptoms, and for this reason be the greater menace.

[1] Read before the Clinical Congress of Surgeons of North America, Chicago, November, 1913.

Chronic blind alveolar abscesses follow a very large percentage of dental work that is apparently mechanically perfect. Gilmer (79) places 25 per cent as a safe estimate of the number of jaws that contain suppurating cavities. To my mind, this prevalence of the disease might throw a doubt upon its seriousness; but I believe that at present we are not in a position to accept such a conclusion, and I have heard Gilmer make the statement that he was of the opinion that possibly every dentist of large practice was a direct or indirect cause of the death of one or more persons yearly, through permitting chronic alveolar abscess to go on indefinitely without being cured, since we are in possession of the facts regarding the various serious inabilities which we can definitely trace to chronic alveolar abscess. Failure to clean out certain tortuous root canals may be dependent not upon the lack of proper operative skill, but because the impossible is attempted (26). The peridental membrane is somewhat elastic, and during mastication a pressure of from 10 to 250 pounds may be brought to bear on a single tooth (39); as a result, a root that extends into an abscess acts as a plunger that tends to force the pus into the lymph-spaces or into any damaged vessel in the abscess wall. The gradual absorption of bone around a peridental abscess may continue until the abscess attains relatively immense proportions, with corresponding destruction of the jaw-bone; and in the upper jaw the maxillary antrum may be directly invaded, giving rise to a submucous or intramucous antral empyema (18, 30, 33). The percentage of antral empyemas that are credited to dental infections is variously estimated up as high as fifty.

Based upon observation made during eighteen years as demonstrator of anatomy in the dissecting room, it is my belief that infection of the antral mucosa of dental origin is rather rare, but that infection and suppuration in the submucosa are exceedingly common. The condition here referred to may be compared to a "gum-boil" within the mouth. The alveolar mucous membrane is red and swollen when there is a submucous abscess, but this cannot be designated as a true antral empyema. I have seen a great many of these submucous antral abscesses in the dissecting room, some of them so large that half of the antral cavity was obliterated, but I have rarely observed a true antral empyema. It is easily understood how, in such a case, the dentist cleaning a root canal might puncture the mucosa and open into the antrum.

As the result of local irritation the epithelium of dental rests may be stimulated into activity, giving rise to the true dental cyst, equally destructive to the bone, and which may also invade the antrum. As many of the so-called odontomata are believed to be of inflammatory origin, these too must be included with the other results of peridental infection, but it is possible that this infection might be metastatic. An infected cyst or the abscess cavity about a root or a sequestrum may cause a chronic fistula opening either within the mouth, maxillary antrum, nasal fossa, or externally. Premature loss of the teeth may cause deformity of the jaw-bones and of the bones of the face and skull (31, 32). The purely local effects of peridental infection are not always of this chronic character. They may be extremely acute and very extensive, going to an acute alveolar abscess, necrosis, cellulitis, or diffuse suppuration. In this connection it is well to bear in mind that in the presence of certain chronic toxæmias, such as mercury, bismuth, phosphorus, and syphilis, peridental infections are prone to light up widespread local destructions (35, 37, 39). Local cellulitis is usually first manifested in the oral soft tissue, but may spread directly to the neck or to any of the facial or cranial tissues, or may be first manifest in the neck as a periadenitis. Two forms of cellulitis of the neck are worthy of special mention: one, the chronic Holzphlegmon, three cases of which we have observed to be of dental origin; and the so-called Ludwig's angina, which latter, when not promptly and properly treated in the past, has been credited with a death rate of 40 per cent. Of nine cases of Ludwig's angina which we have seen, four were unquestionably due to dental sepsis, while but two were clearly due to some other cause (61, 6, 3, 22, 23, 27, 48).

Cervical adenitis of dental origin is commonly either septic or tubercular, the latter being the more important. Moorehead (15, 80) cities Odenthal, who, in examining 978 children between four and thirteen years, found that 429 had progressive caries of the teeth. In 237 of the children the caries was advanced and in these glandular enlargement was more pronounced. In 79 there were other lesions that might account for the lymphangitis. In 359 cases no other cause could be ascribed. In 131 of these the caries was one-sided only, and in all of the cases the glandular enlargement was on the same side. He also found that 99 per cent of children with abscessed teeth had enlarged cervical lymph-nodes, while they were found in only 49 per cent of children with sound teeth.

Hugo Stark (40) found, in 113 children with chronically enlarged cervical lymph-nodes, that 80 per cent had carious teeth, and in 41 per cent of this 80 per cent no other cause, not even heredity, could account for the lymphangitis. The tubercle bacillus is frequently present in the mouths of non-tubercular subjects (78).

Tubercular adenitis has been produced experimentally by infecting the dental pulp. In a few cases of tubercular adenitis the tubercle bacillus was found in a carious tooth corresponding to the infected node (9, 17, 10, 11, 12, 13, 14, 15, 34, 47, 68, 69, 70). Before leaving this region it should be noted that carious teeth are probably a frequent port of entry of the mycoses (63, 19, 24).

We have seen three cases of sarcoma or malignant endothelioma and one of Hodgkin's disease beginning in the cervical lymphatics apparently engrafted upon an acute septic adenitis of dental origin. All four cases died of generalization of the disease.

The tonsils have been proven to be one of the great primary foci of infection; they in turn must be affected by septic material from the teeth, as is the mucosa of the mouth, pharynx, and larynx (6, 17, 64, 20, 29, 18, 21, 48, 79). G. S. Wright (46) has observed that during the eruption of the molar teeth at two, six, twelve and seventeen years, there is a sympathetic enlargement of the tonsils that subsides with each dentition.

Engman was about the first in this country to point out the relation between dental affections and certain mucous and skin lesions—some by direct infection, others through reflex nerve irritation (76, 77, 41, 56, 57, 58, 59, 60).

Sympathetic spasm of the muscles of mastication is a common accompaniment of dental irritation. To a less degree this affects the pharyngeal muscles. We have observed two cases of torticollis with early scoliosis that were relieved by opening an alveolar abscess in each (61).

Whether epidemic parotitis is ever in any way dependent upon caries is not known, but it is now recognized that the so-called metastatic or secondary parotitis is directly dependent on oral sepsis traveling up the excretory duct, and we have been able to express pus from Stenson's ducts before any suppuration was evident in the glands (6, 65, 72). As previously stated ,premature loss of the teeth may change the shape of the jaws and also, secondarily, the nasal chambers. Langworthy (20) has cited irregular eruption of the teeth as a cause of nasal spurs and deviation of the septum. Certain it is that savage races who are relatively immune from dental caries are almost equally free from septal deviations. Nasal obstruction may itself be a cause for oral sepsis and dental caries. The temporomandibular joint may, as any other neighboring structure, be involved in an extensive inflammation arising about a tooth, but this is probably of rare occurrence. Out of 197 cases of ankylosis of the jaw which we have been able to gather from the literature, in only five was infection of the teeth given as a cause. In 12 cases of our own, two were due to scar bands in the cheek due to intra-oral slough, but a dental origin of the sloughing could only be inferred. The cause given was mercurial salivation, but mercurial salivation, like stomacticia and the oral manifestations of scurvy, are practically unknown in the absence of teeth. Like any other joint, the temporomandibular may be indirectly affected by chronic suppuration in any part of

the body (48). In the instances already enumerated, the disturbances in neighboring organs were the direct result of infection spreading from the teeth or of tissue changes due to the subsequent loss of the teeth. When, however, we turn to review the eye, ear, and nervous system in their relation to diseased teeth, we find that at present many of the phenomena can be explained only as reflex irritation (5). In regard to reflex irritation, we must include certain causative factors which are not infections but in many instances are the result of infection. These are chiefly irregular eruption of the teeth, mal-occlusion, impacted teeth, and rough or poorly fitting bridges and fillings.

In 273 cases of baldness, Jacquet noted that 185 occurred during the tooth-erupting period, but very few occurred between 15 and 19 years. He cites one case of right occipito-nuclear baldness in a male of 36 years which was completely relieved after dental treatment. The view that baldness may be dependent upon dental disorders is strongly supported by the French (7, 41, 56, 57, 58, 59, 60).

In reviewing the literature, one finds hints here and there of orbital infection of dental origin, supposed to have traveled upward through the pterygoid or antral plexus of veins (2, 4, 6, 18, 24, 29, 67); these may be accompanied by a case report. Ocular disturbances supposed to be referable to dental disease through reflex irritation seem to be more common. It may be possible that the term "eye teeth" arose from some such supposition, but it is the opinion of most writers on the subject that the cuspids bear no particular relation to the eye; that it is the second and third molars which are more frequently responsible for ocular disturbances. Frick, in 1826, remarked that strabismus was often concomitant with difficult dentition (73). In 1870, Delestra published several cases of visual disturbance related to extraction (73). Herman Schmidt (76) examined the eyes of 92 patients with dental disease, and in 73 of these accommodation was lower on the diseased side, while in 19 it was not affected. Cases of blepharospasm, exophthalmia, amaurosis, retinal hæmorrhage, persistent eye fatigue, neuralgia of the eye, reduced vision, and other ocular disturbances (73, 25, 38, 75) have been reported under circumstances which leave little doubt of their association with dental disorders, but they cannot be common. In this connection, I spoke to an oculist who has had large opportunities for observation and who is conceded to be an excellent clinician. He said that he had examined probably 60,000 cases of eye or orbital troubles, and that he did not remember having seen a single one in which an eye disturbance was directly traceable to a tooth lesion. It may be that the routine of the alveolar process with the X-ray or the Gilmer sharp alveolar probe, in mouths that contain root-fillings, will throw more light on this subject.

Through continuity of the mucous lining of the mouth, pharynx, eustachian tube, and middle ear, infection may travel from one to another; but aside from the well-known fact that pain from a tooth irritation may be felt in the ear, little is known of any direct connection between peridental infection and ear disease. While children are cutting teeth, they frequently have earache, and we have seen such an earache relieved by instilling a cocaine solution into the external ear in cases where there was no suppuration of the tympanic cavity. In these cases the pain may have been due to congestion of the tympanum in common with that of the other mucous membranes (6, 20).

That headache may be due to peridental infection is well known to every clinical observer; we have seen persistent severe headache lasting for months which was relieved by opening a blind apical abscess in an apparently perfectly clean mouth with no local dental symptoms. Extraction of an impacted molar has had a similar effect (18, 27).

Each primary division of the fifth nerve sends off recurrent meningeal branches, and, according to Head, the dental nerves have definite reflex areas due to the innervation of these areas coming from two sources. For instance, a caries of an upper incisor may cause pain or some other reflex manifestation over the frontonasal area. Caries of an upper bicuspid may cause a reflex dis-

turbance over the temple of the same side. An irritation of a tooth insufficient to produce a pain may cause a muscular twitching. The pain of an irritated molar pulp is one often generalized over that division of the fifth nerve, as located in the diseased tooth. Sluder has called attention to the fact that an irritation of the sphenopalatine ganglion from an infected ethymoid cell causes pain over the first and second divisions and over the occiput, which radiates down the neck and arm and even to the leg of that side. We have seen the same thing occur from a blind abscess of a first upper molar (4, 18, 21, 20, 27).

In 94 cases of tic douloureux which we have examined, the origin of the pain seems to have been definitely related to a dental or a peridental irritation in 26, and in 35 out of the 94 the pain began in the third division of the nerve. Of the nervous, mental, and psychic disturbances that have been found to be dependent upon dental disorders, much has been written and much convincing evidence has been put forth in specific instances; but to present more than a few suggestive cases would take us far into the neurologic field, for, as Troemner puts it, all disturbances of the peripheral and central nervous system must be included in considering the neurology of the teeth.

Skiagraphic study of the teeth in 350 neurologic patients with dental disease convinced Upson (46) that in many of them the dental disease was causal rather than casual, and he observed that in 58 cases of mental derangement 30 had impacted teeth (48) and that in 22 of 28 cases of mental derangement operated upon, definite improvement took place within two weeks after operation (45). We have also observed similar instances, and in examining cases of epilepsy that are sent to us for operation we pay particular attention to the condition of the teeth. Goldman (62) describes the case of his 6-year-old daughter who, without determinable cause, began sleep-walking. An enlarged submaxillary node directed attention to the second lower molar, which had been filled six months previously. Removal of the filling showed a concealed caries. The tooth was extracted and the child slept quietly. Holmes (16) cites the case of a boy who became morally delinquent; it was found that some of his first teeth were unerupted and others not yet shed. Treatment of the teeth produced marked improvement in his moral condition. Upson (43) cites two cases of irritability and backwardness at school and of defective mentality cured by dental operations. In 1846, Esquirol (46) described three cases of insanity cured by dental treatment. Many such instances could be quoted, and Kron has in his treatise a bibliography of 248 references on this subject.

In this paper, in pursuance of the title, mention of complications other than affections of neighboring organs has been assiduously avoided; but, as claimed in the beginning, there is no organ or tissue in the whole body that may not be at the mercy of infection that gains entrance through or around the teeth.

BIBLIOGRAPHY


1. Troemner, E. Zahn und Nervenleiden in ihren Zusammenhang. Deutsche Monatschr. f. Zahnh., Leipz., 1912, xxx, 248.
2. Terson, A. The dental Etiology of certain eye troubles. J. de méd., Brux., 1912, xvii, No. 14, 134–136.
3. Gilbert, A. Periostic juxta-amygdaloidean-odontogenom. (These-Toulouse, 1908.)
4. Seydel, F. In how far may we accept a relationship between diseases of the eyes and inflammatory modifications of the bite? Deutsche Monatschr. f. Zahnh., 1912, xxx, 423.
5. Polet, M. Complications of dental caries. Rev. trimest. Belge de Stomatol., 1913, ii, 17.
6. Barden, A. Manuel de la Therapeutique dentaire appliquee. Paris, 1913. Treatment of the casualties of dental evolution, p. 199.
7. Jacquet, L. A case of alopecia of dental origin. Dermatologische Studien (Hamburg & Leipzig), 1910, xxi, 480.
8. Kron, H. Nervenkrankheiten in ihren Beziehungen zu Zahn- und Mundleiden, 1907.
9. Toerne, F. V. Four cases of tuberculosis of the dental pulp. Monatschr. f. Ohrenh., Berl., 1909, xii, 409.
10. Zilz. Tuberkulose des Zahnfleisches. Ergebn. d. g. Zahnh., 1913, iii, 585.
11. Pedley, R. The relationship between dental disease and tuberculosis as it affects the public health. Brit. J. Dent. Sc., Lond., 1912, Dec. 16. p. 779
12. Zilz. The role of dental caries in the phthisiogenetic system. Third Australian Dent. Congress, 1912, p. 118. Beitr. z. Klin. d. Tuberk., 1912, xxii, Nov.
13. Shankland. The dentist and the tuberculosis problem. Dental Summary, 1913, No. 1, p. 72.
14. Wolf, Gabriel. Dental caries and tuberculosis. Oesterr. Ztschr. f. Stomatol., Wien., 1912, p. 316.

15. MOOREHEAD. The teeth and alveolar processes points of entrance for tubercle bacillus. Dental Summary, 1912, p. 143.
16. HOLMES, A. Can impacted teeth cause moral delinquency? Psychological Clinics, 1910–11, iv, 19.
17. NOWELL, W. S. Some effects of erupting and diseased teeth on the lymphatic glands. Arch. Middlesex Hosp., Lond., 1909, xvi, p. 40.
18. HERN, W. The relation of Dentistry to other branches of Medicine. Proc. Roy. Soc. Med., Lond. Lecture on Odontology, 1909–10, iii, p. 1.
19. LORD, F. T. A contribution to the Etiology of Actinomycosis—the experimental production of Actinomycosis in guinea pigs inoculated with the contents of carious teeth. Boston M. & S. J., 1910, Clxiii, 82.
20. LANGWORTHY, H. G. Some borderland problems of Medicine and Dentistry. Dental Cosmos, Phila., 1909, li, 700.
21. PLICQUÉ. Les infections générales d'origine dentaire. Bull. méd., Par., 1913, Jan. 1, p. 8.
22. HESSE. Breast and Neck Abscess of dental origin. Deutsche Monatschr. f. Zahnh., 1909, v, 914.
23. HESSE. Septicæmia of bucco-dental origin. Abstract L'odontologie, 1912, v, 312.
24. ZILZ, I. Carious teeth, as a port of entry for the agents of actinomycosis. Oesterr.-ung. Vrtljschr. f. Zahnh., 1910, xxvi, 528.
25. MACWHINNIE. The teeth and their relation to the eye. N. Y. M. J., xcviii, 755.
26. GRIVES, C. J. Systemic Pus Poisoning with diseased dental apical Regions. Items of Interest, N. Y., 1911, xxxiii, 339.
27. CHAPMAN, W. L. Suppurative conditions of the alveolar process. Dental Cosmos, Phila., 1913, lv, 263.
28. MURPHY, W. E. Pathologic relations of the tonsil to the teeth. Dental Summary, 1912, xxxii, 579.
29. BELONGT, MAX. Contribution à l'étude des suppurations de la region palpebro-lacrymale d'origine Dentaire. Paris, 1911.
30. UNDERWOOD, B. Some dental aspects of empyema of the maxillary sinus. Brit. J. Dent. Sc., Lond., 1913, lvi, 3.
31. STILLWELL, F. S. Relation of orthodontia to the general health and development of the child. Lancet-Clinic, 1912, cvii, 680.
32. POTT, H. A. A frequent etiological factor common to facial malformation and acute infectious diseases. Interst. M. J., 1911, xviii, 208.
33. PRINZ, H. From the borderland of Medicine and Dentistry. Interst. M. J., 1913, xxvii, 229.
34. MORLEY, F. The relation of Dental Disorders to Tubercular Disease. Brit. J. Child. Dis., 1909, vi, 7.
35. MEDALIA, L. S. Chronic Alveolar Osteo-myelitis (pyorrhœa alveolaris), its Causes and Treatment with Vaccines; with bacteriologic study and report of 115 cases. Boston M. & S. J., 1912, clxvii, 868.
36. LEDERER, W. J. Relationship between Dental and Systemic Disturbances. N. Y. M. J., 1908–1909, lxxxix, 65.
37. BRAN, M. R. Report of a case of Simulated and one of a True Maxillary Empyema, both of Dental Origin. J. Am. M. Ass., 1912, lviii, 1910.
38. BRUNER, W. E. Relation of the Teeth to the Eyes. Ann. Ophthal., St. Louis, 1912, xxi, 744.
39. HARTZELL, THOS. B. Responsibility of the Dentist and Physician in Regard to Mouth Infections and Their Relation to Constitutional Effects. J. Am. M. Ass., 1913, October 4, 1270.
40. STARK, HUGO. Tubercular Glands of the Neck and their Relation to Carious Teeth. München. med. Wchnschr., 1896, xliii, 145.
41. SIBLEY, W. K. Relation between the Teeth and certain Diseases of the skin and Mucous Membrane. Proc. Roy. Soc. Med., Lond., Odont. Sec., 1910–1911, iv, 71.
42. BAKER, L. W. Dental Caries as a Factor in the Etiology of other Diseases. Boston M. & S. J., 1908, clviii, 401.
43. UPSON. H. S. Dental Irritation as Cause of Mental Aberration and Defect in Childhood. Rev. Neurol. & Psychiat., Edinburgh, 1910, viii, 457.
44. UPSON, H. S. Dental Disease as it Affects the Mind. Monthly Cyclopedia Med. Bull., Phila., 1912, v., 129.
45. UPSON, H. S. Painless Dental Disease as the Cause of Neurasthenia and Insanity. Cleveland M. J., viii, No. 8, 447.
46. WRIGHT, G. H. The Teeth and their relation to the Body. Boston M. & S. J., 1912, clxvii, 799.
47. YOUNG, R. J., and WALLACE, J. S. Children and Dental Diseases. Brit. M. J., Lond., 1912, ii, 353.
48. POTTS, H. A. The teeth as an Important Factor in in Pathogenesis. J. Am. M. Ass., 1910, lv, 492.
BUSH, B. E. Close relation of Dentist to Physician. J. Am. M. Ass., 1910, iv, 752.
49. DAUZATS. Recherches sur la Contagiosité de la pélade. Thèses de doct., Par., 1901.
50. DELAVARENNE. La question de la pélade. Presse méd., Paris, 1902, x, 171.
51. EYRE and PAYNE. Observations on the bacteriology of pyorrhœa alveolaris and Treatment of Disease by Bacterial Vaccines. Proc. Roy. Soc. Med., Lond., Odont. Sec., 1910, iii, 29.
52. GOADBY. Two Cases of Acute Pyorrhœa Alveolaris, Treated by a specific Vaccine. Brit. M. J., 1908, ii, 477, and Lancet, 1911.
53. HEAD. On disturbances of Sensation and the Pain of Visceral Disease. Brain, 1894, xvii, 406.
54. HUNTER, W. Oral Sepsis. Practitioner, Lond., 1900, lxv, 611.
55. JACQUET. La pélade d'origine Dentaire. Ann. de dermat. et syph., Par., 1902, iii, 97.
56. PEDLEY, R. D. The Relationship between dental and other Diseases. Tr. Odont. Soc. Gr. Brit., Lond., 1905, N. S. xxxvii, 67.
57. SIBLEY. Non-Contagiousness of Cancer. Tr. Path. Soc., Lond., 1891, xlii, 381.
58. SIBLEY. Stomatitis Neuratica Chronica. Brit. M. J., 1899, i, 900.
59. TRÉMOLIÈRES. Presse méd., Par., 1902, x, 567.
60. TURNER, J. G. Pyorrhœa Alveolaris, Primary External Peridental Infection and Oral Sepsis. Practitioner, Lond., 1910, lxxxiv, 115.
61. BLAIR, V. P. Surgery and Diseases of the Mouth and Jaws.
62. GOLDMANN, R. Ein Fall von Akutem Somnambulismus Infolge eines Periostisch Erkrankten Zahnes. Wein. Klin. Wchnschr., 1912, xxv, 1292.
63. ISREAL. Neue Beobachtungen auf dem Gebiete der Mykosen der Menschen. Virchow's Arch. f. path. Anat., etc., Berl., 1878, lxxiv, Bd. 15.
64. COLYER, I. F., and COLYER, STANLEY. Dental Disease in its Relation to General Medicine. London, 1911.

65. BUCKNALL. Parotitis. Lancet, Lond., 1905, Oct. 21.
COLYER. Oral Sepsis and General Disease. J. Brit. Dental. Ass., Lond., xxiii, 409.
DANIEL. Overlooked Infections. Lancet, Lond., 1910 Jan. 15.
EWART. Fatal Endocarditis. Brit. M. J. 1900, Sept. 20.
66. GOADBY. Pathology of Oral Sepsis. Brit. M. J., 1904, Nov. 19.
GODLEE. Continuous Local Infections. Lancet, Lond., 1903, Dec. 5.
67. HARMAN, N. B. Orbital Periostitis. Brit. M. J., 1909, Sept. 25.
68. HOPPE. Carious Teeth and Enlarged Lymph Glands. Brit. M. J. Dental Sci., xxxviii, 597.
HUNTER, W. Paper on Anæmia. Lancet, Lond., 1900, Jan. 27, Feb. 7, 10.
HUNTER, W. Complications of Scarlet Fever. Brit. M. J., 1906, Feb. 24.
HUNTER, W. Relation of Dental Disease to General Diseases. Tr. Odont. Soc. Gr. Brit., Lond., 1898–9, xxxi, 92.
HUNTER, W. Oral Sepsis and General Medicine. Brit. M. J., 1904, Nov. 19.
69. MILLER. Glandular Enlargements. Brit. J. Dental Sci., xli, 97.
70. MORGAN. Glandular Enlargements. J. Brit. Dent. Ass., Lond., xxiv, 521.
PEDLEY. Complications of Pyorrhœa. Dental Rec., Lond., xx, 337.
WIEGMANN and Others. Local Sepsis and Rheumatism. Lancet, Lond., 1909, Dec. 4.
71. WALLIN, J. E. W. Experimental Oral Orthogenesis. J. Philosophy, Psychol., etc., 1912, ix, 290.
72. GAVEN, W. P. Importance of Dental and Oral conditions. Dominion Dent. J., 1911, Nov., xxiii, 525.
73. HIGGS, A. K. Ocular Disturbances the Result of Dental Disease. J. Ophth. and Otolaryngol., 1911, April, ii, 127.
74. NANCE. Ocular Disturbances Ascribed to Morbid Condition of Teeth. J. Am. M. Ass., 1904, 889.
75. WEINBERG. Reports Exophthalmia with Redness of Bulbar Conjunctiva, Hazy Vision, etc. Rec. d'opth., Par., 1882, p. 441.
76. ENGMAN. Affections of the Mucous Membrane in Relation to Skin Disease. J. Cutan. Dis., 1904, p. 413.
77. VOLKMANN. Emige Falle von Cheilitis Glandularis Apostematosa. (Myxadenitis labialis.) Virchow's Arch. f. path. Anat., etc., Berl., 1870, p. 142.
78. GILBERTI. Medical Practice Series, 1910, iii, 313.
79. GILMER. Arch. Inter. Med., ix, 499.
80. ODENTHAL. Therapie des Maladies infectieuses, p. 256.
81. MILLER. Dental Cosmos, 1891, Sept., 689.
82. BLACK. American System of Dentistry.

# PRIMARY CARCINOMA OF THE LIVER IN CHILDHOOD

## With Report of a Case

By O. L CASTLE, M. D., Kansas City, Missouri

PRIMARY carcinoma of the liver at any age is a rare condition. In White's (43) observations in 11,500 autopsies, 11 were noted. Virchow noted 5 cases in 6000 autopsies. Before Virchow's differentiation of primary and secondary carcinoma, practically all cancers of the liver were classed as primary. But observations since then have shown primary cancer to be rare indeed. It has been estimated that "the proportion of undoubtedly primary to secondary carcinoma of the liver is as 1:25" (White).

As to age incidence, Hanot and Gilbert (44) say: "Primary cancer of the liver presents its maximum frequency from 40 to 48, is rare from 30 to 40, and is exceptional under 30." White states that "hepatic cancer is all but unknown under 20."

A number of splendid reports are in the literature on carcinoma of the liver. Hanot and Gilbert report 24 cases, none of which occurred in childhood. However, they cite two cases previously reported, one by Deschamps (14) in a boy aged 11 years, and one by Wulff (19) in a child aged 3. Eggel (46), in a very complete and voluminous report, reviews 117 tabulated cases that were microscopically diagnosed. Three cases occurred in childhood: 14 years (Pye-Smith (21)), 12 years (Birch-Hirschfeld (20)), and 2 months (Pepper (11)). Of 45 additional cases not microscopically diagnosed, but one occurred in childhood: 9 years (Kottmann (18)).

Phillip (47) has contributed a very valuable review on carcinoma of the liver in childhood. He has classified his collaboration under three heads: First, the authentic cases, in which series he has collected 12 cases ranging in age from 14 months to 14 years. Second, the probable cases, in which are 10, ranging in age from one day to 14 years. Third, the doubtful cases, in which are classed 7, ranging in age from 3 months to 12 years. He reports no new cases.

Ackland and Dudgeon (23) report 7 cases of primary carcinoma of the liver in childhood collected from the literature, as well as their own case, which occurred in a boy aged 15.

Karsner (32) has contributed to the study of primary carcinoma of the liver, two of his cases occurring in childhood — a girl aged 11 years and a boy aged 8. He also discusses the pathological classifications of the liver cancers.

Burt (30) has reported a primary adenocarcinoma of the bile-duct type occurring in a 12-year-old boy.

Peifer (34) in addition to reporting a case of primary carcinoma of the liver in a 9-month-old child, discusses the various types of cells that enter into the formation of liver cancers.

Fussell and Kelly (41) report a primary trabeculo-alveolar carcinoma of the liver with cirrhosis occurring in a girl aged 16. This is the oldest case recorded in our tabulation.

The Japanese have made valuable contributions on their observations of primary carcinoma of the liver in childhood. Nagasawa and Nakamura (38) have reported a case in a 17-month-old child. They cite a similar case reported by Miwi and Utsumi (39). Miwi and Saito (40) have reported a primary parenchymatous adenocarcinoma in a girl aged 5 years and 5 months. Idzumi (37) has reported a primary liver carcinoma in an infant of 7 months. In this tumor was also found osteoid tissue. Yamagiwa (36) has reported a primary teratoid adenocarcinoma in a girl one year old.

Milne (31) has added a case of simple liver-celled adenoma in a child of 6 months. His illustrations add greatly to the study of epithelial tumors of the liver.

In the article contributed by Musser (45) in the "Cyclopædia of Diseases of Children," 10 cases of carcinoma of the liver occurring in childhood are tabulated.

*Symptoms.* The symptoms of this condition are as variable as the location, extent, and toxicity of any malignant disease. The cases reported show in general the following:

1. Cachexia, anæmia.
2. Gastric or right hypochondriac pain.
3. Tumor in abdomen.
4. Icterus when bile exits are occluded.
5. Ascites when portal or lymphatic obstruction occurs.
6. Terminal fever.

Nearly all of the deaths were described as being caused by cachexia and asthenia.

*Duration.* This is reported indefinitely, from 14 days to one and one-half years.

*Gross tumor classification.* Primary carcinoma of the liver is classed under three types: (*a*) nodular, (*b*) massive, (*c*) diffuse. In our tabulation diffuse is very rare, and three nodular occurred to one massive type. This conclusion is drawn from the cases that are sufficiently described to warrant opinion as to gross characteristics. The size of the tumor is also subject to wide variation. Nodules of all sizes are described. The largest is that described by Ackland and Dudgeon (23), in which case the liver weighed 15 pounds.

*Microscopic classification.* In general, two classes are noted, simplex and adeno. However, the results of analysis of our tabulation will show a very complex record as regards terminology, for it must be remembered that several of the cases were reported before accurate microscopic classification was possible.

*Metastasis.* Accurate data regarding metastasis are wanting. In some reports no observations were recorded. In others only the abdomen was explored, thereby making it impossible to state accurately the extent of the disease. However, records show that most frequently metastases occurred in the liver and lungs. Some cases showed portal vein invasion.

*Résumé of Tabulated Cases.* Number of cases, 42. Age, 1 day to 16 years. Average age, 6 years and 4 months. Sex, male, 19; female, 14; unclassified as to sex, 9. Metastases in 9 cases, no metastases in 10(?); unclassified as to metastases, 23. Gross classification, nodular type, 14; massive type, 5; diffuse type, 2; unclassified as to type, 21. Microscopic classification, adenocarcinoma, 16; carcinoma of the liver, 7; medullary cancer, 6; cancer of the liver, 6; alveolar carcinoma, 2; adenoma, 2; carcinoma solidum, 1; alveolar cancer, 1; scirrhous cancer, 1; total, 42.[1]

The case which came under our observation is the massive type of primary parenchymatous adenocarcinoma of the liver.

*History.* P. E., Jr., residence, Slater, Missouri. Male child, ten and one-half months old. Normal delivery at term (born May 30, 1912).

*Family history.* Parents both American; father 35, mother 32. Two other children, both well and normal. No history of carcinoma in family of mother. Father says that great-grandfather died of carcinoma, aged 80. Absence of specific history in parents. No evidences of tuberculosis.

*Personal history.* Baby was on breast milk from May to December, 1912, and until November was an unusually robust child. No constipation and no disturbances of digestion until November. At that time he had a cold, and his physician thought that he was having an attack of influenza. A slight cough persisted, and the baby was placed upon artificial feeding. Several foods were tried.

*Present trouble.* At the age of five months the abdomen was quite prominent, but no tumor could be palpated at that time. Since January it has been perceptible that the right side of the abdomen was abnormally prominent. Increasing disturbances of digestion, with persistent tympanites, caused the mother to become alarmed and bring the child to Dr. Frederick M. Lowe of Kansas City,

*Examination,* April 7, 1913. Patient pale and showing considerable emaciation. Abdomen very tense and gas in the bowels causing considerable distress. Enema caused the expulsion of a great deal of gas and revealed bulging forward of abdomen on right side. A mass on right side palpable, filling all the space from ribs to inguinal fold. Mass reaches the median line of the abdomen. No fluctuation obtainable. Percussion fails to demonstrate ascending colon over the mass. Auscultation of chest negative, although there has been slight cough persisting for several months. Urine examination shows specific gravity 1015, and alkaline reaction. There is no albumin nor sugar. Microscopically shows no leucocytes nor erythrocytes, but a few coarse hyaline casts along with a heavy deposit of phosphates. A von Pirquet tuberculin test is negative. Baby has been fed on a mixture of milk and Mellin's Food for a month. Some constipation, but stools show no curds. Baby was being overfed, and a reduction in the amount of proteids produced a marked improvement in digestion.

[1] NOTE. The author is fully aware that it is practically impossible to present a "complete" list of the reported cases. However, this list includes all the cases that are to be found in the indexed literature to which have been added a few additional cases. In general, this table is patterned after the plan used by Phillip. Bibliographical citations in the first 17 cases and most of Cases 18 to 29 have been taken from Phillip's report. The author has added Cases 30 to 42 to the table. Different authors have tabulated the same cases in their reports, thereby making it appear that the aggregate number should be larger than it is.

## TABULATED CASES OF PRIMARY CARCINOMA OF THE LIVER IN CHILDHOOD

| Case | Age | Sex | Diagnosis | Author | Publication |
|---|---|---|---|---|---|
| 1 | 18 mos. | F. | Medullary cancer of the liver | Olivier | Clin. d. Hôp. d. Enf., 1841, iv, 833. |
| 2 | 3 mos. | M. | Scirrhous cancer of the liver | Gross | Am. Med.-Chir. Rev., 1857, i, 414. |
| 3 | 8 mos. | M. | Medullary cancer of the liver | Ch. West | Kinderkrankh., 1857, ii, Aufl. |
| 4 | 12 yrs. | F. | Medullary cancer of the liver | W. Roberts | Lancet, Lond., 1867, i, 77. |
| 5 | 17 mos. | ? | Carcinoma of the liver | Affleck | Trans. Edinb. Obst. Soc., iv. |
| 6 | 7 mos. | M. | Liver cancer; cancer of peritoneum | Lichtenstern | Ziemmsen, Spez. Path. u. Therap., viii, 321. |
| 7 | ? | M. | Liver cancer | Küstner | Jahrb. f. Kinderh., N. F., 1883, xx. |
| 8 | 1 day | F. | Medullary cancer of the liver | E. Noeggerath | Deutsche Klin., 1854, vi, 496. |
| 9 | 3 days | ? | Alveolar cancer of the liver | H. Widerhofer-Wedl | Jahrb. f. Kinderh., 1859, ii, 191. |
| 10 | 13 yrs. | M. | Medullary cancer of the liver | Le Wiss | Zentralztg. f. Kinderh., 1877, i, 73. |
| 11 | 2 mos. | ? | Cancer of the liver | Pepper | Gerhardt's Handb. d. Kinderkrankh., iv, 830. |
| 12 | 4 yrs. | ? | Cancer of the liver | S. Gee | St. Barth. Hosp. Rep., vii, Zit. n. Rueder's Diss. |
| 13 | 14 yrs. | F. | Cystic medullary cancer of the liver | Henschen | Ref. Jahrb. f. Kinderh., 1885, xxiii, 468. |
| 14 | 11 yrs. | M. | Cancer of the liver | Deschamps | La France Méd., 1885, 809. |
| 15 | 11 yrs. | M. | Adenocarcinoma of the liver | Bonome | Zit. bei Burt, 97. |
| 16 | 20 mos. | F. | Atypical liver-celled adenoma | St. Joseph-Kinderspital | Arch. f. Kinderh., 1886, vii, 138. |
| 17 | 6 mos. | ? | Cancer of the liver | Bohn | Langenbuch's Chir. der Leber u. Gallenblase, ii, 58. |
| 18 | 9 yrs. | F. | Primary carcinoma of the liver | A. Kottmann | Cor.-Bl. d. schweiz. Ärzte, 1872, No. 21, 439. |
| 19 | 3 yrs. | F. | Primary adenocarcinoma of the liver | H. Wulff | Gerhardt's Handb. d. Kinderkrankh., 1879, iv, 827. |
| 20 | 12 yrs. | M. | Primary adenoma of the liver with carcinoma change | Birch-Hirschfeld | Gerhardt's Handb. d. Kinderkrankh., 1879, iv, 828. |
| 21 | 14 yrs. | M. | Primary alveolar carcinoma of liver | Pye-Smith | Lancet, Lond., 1880, i, 405. |
| 22 | 14 yrs. | F. | Primary carcinoma of the liver | Engelhardt | München. med. Wchnschr., 1900, xlviii, 631. |
| 23 | 15 yrs. | M. | Primary spheroidal-celled carcinoma of the liver | Ackland and Dudgeon | Lancet, Lond., 1902, ii, 1310. |
| 24 | 4 yrs. | M. | Primary carcinoma of the liver | Schlesinger | Jahrb. f. Kinderh., 1902, lv, 300. |
| 25 | 10 yrs. | F. | Primary carcinoma of liver; cirrhosis | Grawitz | Deutsche med. Wchnschr., 1903, H. 36, 286. |
| 26 | 12 yrs. | M. | Primary adenocarcinoma of the liver | St. Smith Burt | Deutsche med. Presse, 1904, viii, 96. |
| 27 | 9 yrs. | M. | Primary adenocarcinoma of the liver | Mattirolo | Gaz. d. Osp., 1905, ii, Jan. |
| 28 | 14 mos. | M. | Primary adenocarcinoma of the liver | Plant | Arch. f. Kinderh., 1906, xliii, 250. |
| 29 | 7 yrs. | F. | Primary adenocarcinoma of the liver | Lubarsch and Phillip | Ztschr. f. Krebsforsch., 1907, v, 361. |
| 30 | 12 yrs. | M. | Primary adenocarcinoma of the liver | S. S. Burt | Post-Graduate, 1903, xviii, 991. |
| 31 | 6 mos. | M. | Primary adenoma of the liver | Milne | Jour. Path. and Bacteriol., 1909, xiii, 348. |
| 32 | 11 yrs. | F. | Adenocarcinoma of liver; cirrhosis | Karsner | Arch. Int. Med., 1911, viii, 238. |
| 33 | 8 yrs. | M. | Carcinoma solidum of the liver | Karsner | Arch. Int. Med., 1911, viii, 238. |
| 34 | 9 mos. | ? | Primary carcinoma of the liver | A. Peifer | Jahrb. f. Kinderh., 1912, lxxv, 690. |
| 35 | 6 yrs. | M. | Primary carcinoma of the liver | La Page | Proc. Roy. Soc. Med., 1912, vi, 45. |
| 36 | 1 yr. | F. | Teratoid adenocarcinoma of the liver | Yamagiwa | Virchow's Archiv, 1911, ccvi, 437. |
| 37 | 7 mos. | ? | Primary adenocarcinoma of the liver | Idzumi | Arch. f. klin. Chir., 1913, c, 1181. |
| 38 | 17 mos. | ? | Primary parenchymatous adenocarcinoma of the liver | Nagasawa and Nakamura | Jikazasshi, 1911, No. 128—Ref. Ztschr. f. Kinderh., 1911, i, 631. |
| 39 | ? | ? | Similar to case 38 | Miwi and Utsumi | Jikazasshi, 1910, No. 119—Ref. Ztschr. f. Kinderh., 1911, i, 631. |
| 40 | 5½ yrs. | F. | Primary parenchymatous adenocarcinoma of the liver | Miwi and Saito | Jikazasshi, 1912, No. 142—Ref. Ztschr. f. Kinderh., 1913, iv, 683. |
| 41 | 16 yrs. | F. | Primary trabeculo-alveolar carcinoma of the liver with cirrhosis | Fussell and Kelly | Trans. Am. Ass. Phys., 1895, x, 108. |
| 42 | 10 mos. | M. | Primary adenocarcinoma of the liver | O. L. Castle | |

*Clinical diagnosis.* The tumor seemed a part of the liver, but sarcoma of the kidney was deemed more probable. Consent of parents for operation was obtained April 13th. Dr. Jabez N. Jackson was called and operation was done at University Hospital on April 14, 1913.

*Operation.* Upon opening abdomen, by right rectus incision, a large spheroidal tumor was found growing from anterior margin of right lobe of liver, beginning about 2½ cm. to the right of gall-bladder and extending about 8 cm. to the right (Fig. 1). The tumor did not encroach greatly upon the liver substance, so that the so-called pedicle varied from 1 to 3 cm. in width. There was a small amount of free normal appearing peritoneal fluid. The tumor dragged the liver down until the bottom of the tumor almost reached the level of the pubes and the left margin extended slightly past the median line. There were a few adhesions posteriorly. There was no evidence of secondary tumors in the liver or elsewhere. The operative technique is outlined in the following: The pedicle in liver was clamped in a V-shape with two gastro-enterostomy clamps protected by rubber tubing. The tumor was removed by cutting close to clamps. A roll of gauze was placed to cover cut-surfaces. Then a row of running sutures was placed over gauze and clamps. These sutures were set lightly as clamps were withdrawn. One large vessel required ligature. Then a row of deeper interrupted catgut sutures brought the compressed, gauze-covered surfaces snugly together. This method controlled the hæmorrhage very successfully. The laparotomy wound was closed in the usual way, leaving the gauze-roll compress as drainage.

In the literature we have not been able to find a case where there was a surgical excision of a primary adenocarcinoma of the liver in an infant. Some cases have been explored, and in others a small portion of the tumor has been removed for microscopic diagnosis. However, this case is unique in a complete removal of the tumor by surgical operation.

*Post-operative history.* The child made a rapid, uneventful surgical convalescence. Temperature did not go over 101°. Drains and gauze compress removed on eighth day. Child took nourishment well and gained in weight. Upon the earnest request of the mother, she was permitted to take the child home on the fourteenth day after operation. The day after leaving the hospital the child was taken violently with symptoms of acute gastro-enteritis, and after 24 hours death took place. Necropsy was not permitted, although zealously urged.

PATHOLOGICAL REPORT

*Gross description.* The specimen is an encapsulated, globular, pear-shaped tumor with prominent dilated blood-vessels showing in the capsule. The surface is uneven, due to prominences produced by nodular tumor growths. At its upper pole there is an irregular, roughened, sickle-shaped area about 5 cm. in length which represents the pedicle attachment to the liver (Fig. 2). The consistency is rather firm; the color is reddish brown interspersed here and there with a grayish white nodular area. These colors are not sharply defined, due to the opacity of the capsule. At the pedicle are two more prominent grayish white nodules that bulge under the capsule. The tumor measures 12.5 cm. in perpendicular diameter, with corresponding circumference of 35 cm.; the horizontal diameter is 10 cm., with corresponding circumference of 31 cm. Weight, 651 grams.

Upon gross section of the tumor through longest diameter and including pedicle, we find that the tumor mass presents a varied appearance; toward the capsule are noted more distinct grayish white nodules, while toward the center there are irregular grayish honeycombed masses interspersed here and there with dark red blood-containing areas (Fig. 3). Upon closer inspection the blood is seen to be confined in small multiple cystic spaces separated by a fine whitish web-like tissue. In the upper central part there is a liberal coloring of olive green bile-stain. This color is not confined to any single area. The capsule is of firm fibrous tissue. Over the anterior surface there is just the capsule covering the growth; over the posterior side, in addition, there is a thin layer of compressed liver tissue, covered by a thin Glisson's capsule. This liver substance is directly continuous with that of the liver proper. At pedicle attachment it is seen that two grayish nodules have broken through the capsule and are in direct apposition to liver parenchyma. In some of the more extensive grayish white areas mucoid degeneration is evident. In only one large circumscribed nodule is there simple softening, and this is not extensive. The blood-vessels are not prominent except

Fig. 1. Drawing showing relative size and position of tumor, pedunculated and extending from right lobe of liver past median line and into pelvis.

Fig. 2.

Fig. 3.

Fig. 2. Gross tumor with pedicle at top. Note dense fibrous capsule with prominent engorged blood vessels.

Fig. 3. Section of tumor showing spongy appearance of substance due to blood-spaces. Large light central areas show softening. Note also where tumor tissue has broken through fibrous capsule and has invaded liver substance at pedicle attachment.

in the capsule. There are noted a few small vessels in the internodular connective tissue.

*Microscopic findings.* Sections were cut from several areas representative of the variable appearances presented in the gross specimen. Sections stained with Delafield's hæmatoxylin and eosin, Van Gieson's stain, Weigert's elastica stain, and Sudan III.

*Microscopic description.* The cells composing the tumor are rather complex (Fig. 4). There is a quite wide variation in size. In some portions the cells are large and spheroidal or polyhedral; in others the cells are smaller and are of low cylindric or cubic shape. The cytoplasm is finely granular and shows occasional cells containing a very small amount of fat in fine globules. It has not been possible to demonstrate glycogen granules in the cells. For the most part, in the cubical cells, the cell boundaries are sharply defined; while in the larger spheroidal type the boundaries are diffuse and poorly differentiated. The large nucleus is centrally placed and is of vesicular type, with a single sharply defined nucleolus. The chromatin has a web-like distribution, radiating from the centrally placed nucleolus. Karyokinesis is occasionally noted. This is most prominent in nodules which have broken through the tumor capsule, as is shown in Fig. 5.

The architecture of the tumor is essentially that of a tubular neoplasm (Fig. 6). The cells are arranged in tubules of variable size, from one or two cell layers in thickness to as many as twenty or more. The central lumen is also of variable size, in some areas not clearly made out, while in others appearing as a large cystic space in the section. The contents of the larger spaces show an undetermined granular detritus with a good many

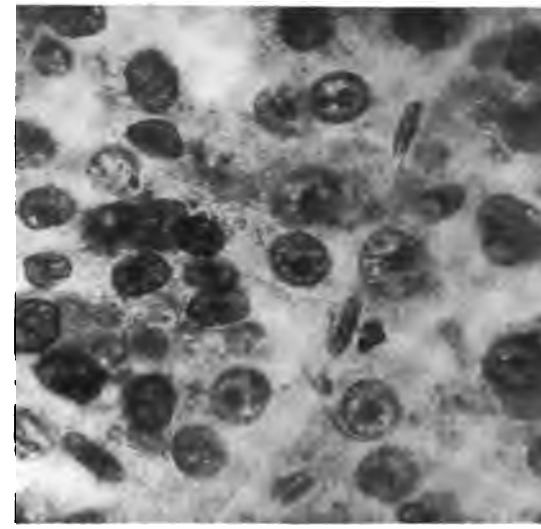


Fig. 4. Photomicrograph (Spencer 1/12, Ocular 8X). Section from same area as VII, showing vesicular nucleus with definite nuclealus, the chromatin having a webblike distribution. The cells have a finely granular cytoplasm. In areas the cell boundaries are very indistinct. There is considerable variation in size. A fine capillary lined by endothelial cells traverses this field.

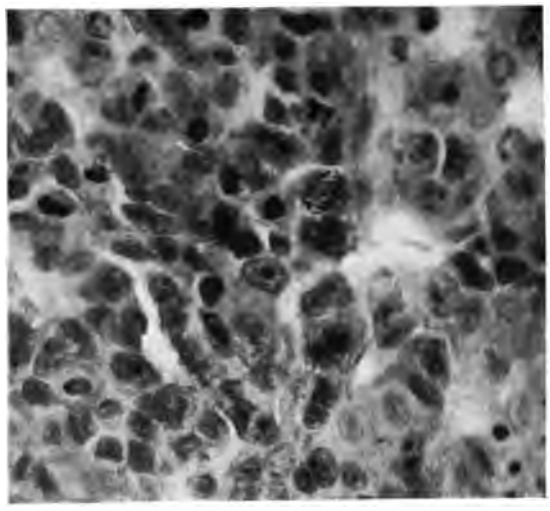


Fig. 5. Photomicrograph (Spencer 1/6, Ocular 8X). Section taken from area where tumor has broken through capsule, showing active mitoses of cells.

Fig. 6. Photomicrograph (Spencer 2/3, Ocular 8X). Section taken from whitish mass in tumor. Note the essentially tubular arrangement of tissue, most of the tubules being cut tangentially. In right upper area is one isolated tubule cut at right angles. Note the fine capillary network separating tubules.

polymorphonuclear leucocytes (Fig. 7). In some areas the tissue has a trabeculated or alveolar arrangement where the tubules have been cut tangentially. The tubules are separated by an interlacing capillary network lined by flat endothelial cells. In the grayish nodules the capillaries show occasional microscopic dilatations, where it is seen that the lumen is filled with blood. In sections taken from the red, spongy areas it is found that the blood is not a hæmorrhage but is confined in enormous dilatations of these intertubular capillaries. Many polymorphonuclear leucocytes are contained in the blood clots.

Blood-vessels are not prominent except in the firm fibrous capsule, which is not differentiated from the capsule of Glisson except at the pedicle attachment. There is noted in sections taken from the centers of the large grayish areas a simple parenchymatous degeneration. Near these areas the fatty droplets in cells are plentiful. In some portions there is a moderate mucoid degeneration. Weigert's elastica stain shows a lack of elastic fibrils except in the blood-vessels and in the perivascular connective tissue. Van Gieson's stain shows the connective-tissue fibrils in the intertubular capillaries.

In a neoplasm of this nature the consideration of etiology of the cell is very important. It has been possible to demonstrate cells identical with the tumor cells lying in apposition to compressed parenchymal liver cells, as is shown in Fig. 8. These cells have no resemblance to the bile duct epithelium, but resemble more nearly the atypical fœtal parenchymal liver cells. Upon careful search with high power, it is possible to find (as in Milne's case) a column of true liver cells which is continuous with the neoplastic cells (Fig. 8). This should make positive the origin of the tissue. The fact, also, that the tumor cells are of epithelial character, having a gland-like arrangement, and that they have broken through the capsule and are invading the liver tissue proper, justifies the diagnosis of adenocarcinoma.

The case presented falls in the class of the congenital primary parenchymatous adenocarcinoma of the liver. Tumors of this same character have been reported in even younger subjects than the case presented, making it certain that the neoplasm was prenatal in origin. The author has noted teratoid tumors in the new-born that resemble this case in many characteristics; and one case (Yamagiwa), is classed as a teratoid adenocarcinoma of the liver in a one-year-old girl. Again, Idzumi reports a primary adenocarcinoma of the liver in a child aged seven months, which in addition to mucous tissue, etc., contained distinct areas of osteoid tissue. He concludes that the tumor was of congenital origin

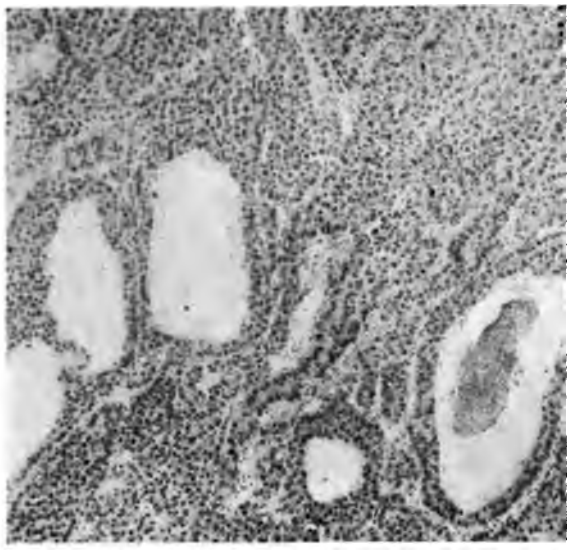


Fig. 7. Photomicrograph (Spencer 2/3, Ocular 8X). Similar to Fig. 6, and showing blood detritus in one oval space. Note irregular alveolar arrangement of cells. Also note the fine interlacing capillary system lined by endothelial cells, showing occasional dilatations filled with blood-cells.

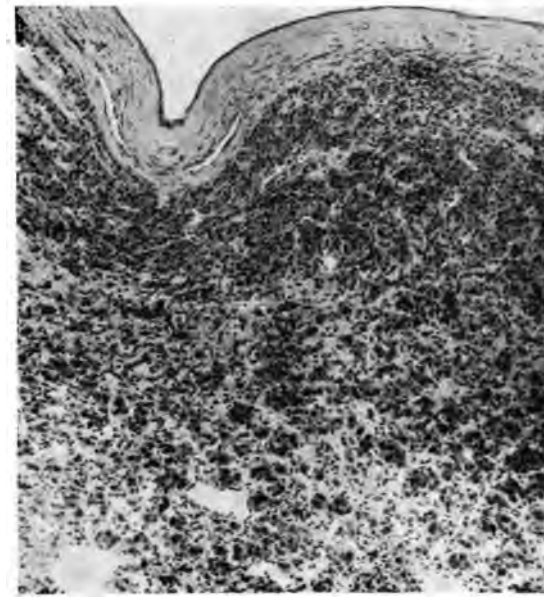


Fig. 8. Photomicrograph (Spencer 2/3, Ocular 8X) showing capsule of Glisson, compressed liver tissue, and the blending into the hyperplastic cells identical in appearance to the tumor cells.

and that it contained misplaced embryonal rests.

The differentiation of adenoma and adenocarcinoma has been considered by various authors. For instance, Milne classes his case as a simple liver-celled adenoma. His case is in every way similar to ours, except that the tumor had not broken through the capsule and had not invaded the liver parenchyma. However, his case is classed with the adenocarcinomata in the tabulated cases.

## CONCLUSIONS

I. There are reported in the literature, 42 cases of cancer of the liver in childhood (under 16), with the majority of diagnoses accurately made.

II. Our case is unique in the following respects:

1. A pedunculated primary parenchymatous adenocarcinoma of the liver in an infant.

2. The first case reported where complete surgical excision was done.

3. Good surgical convalescence, with death 16 days after operation from symptoms of acute enteritis. No post-mortem examination.

I wish to acknowledge my thanks to Dr. Frederick M. Lowe for the medical aspects of the case and to Dr. Jabez N. Jackson for the surgical data and the suggestion for making this report.

## ADDITIONAL BIBLIOGRAPHY

43. WHITE. Allbutt's System of Medicine, 1897, iv, 197.
44. HANOT and GILBERT. Études sur les maladies du foie. 1888.
45. MUSSER. Cyc. of the Diseases of Children, 1890, iii, 461.
46. EGGEL. Beitr. z. path. Anat. u. z. allg. Path., 1901, xxx, 506.
47. PHILLIP. Ztschr. f. Krebsforsch., 1907, v, 361.

# MOBILIZATION OF THE DUODENUM

By ALLEN B. KANAVEL, M. D., Chicago

THE ease with which the third or inferior horizontal portion of the duodenum can be exposed and mobilized is not, I believe, generally appreciated. An experience with two cases of extraperitoneal rupture of the duodenum emphasized the necessity for free mobilization and in the second I fell upon the method here described. It has served me well also in those cases in which it is necessary to examine the head of the pancreas or the entrance of the common bile-duct into the intestine.

As is well known, Kocher (1) suggested a method of mobilizing the duodenum in which the peritoneum covering the right kidney is incised vertically an inch outside of the second portion of the duodenum; this is then detached inwards with the head of the pancreas.

Fig. 1. Drawing showing the retrocolic mesentery, the omentum being thrown upward. Note the bulging of the retroperitoneal tissue over the site of the duodenum. The dotted line illustrates the length and direction of the incision which is to be made in the line of the blood supply.

Fig. 2. Shows incision dilated with the fingers and retracted with the fingers and retractor. Note that the head of the pancreas is in plain view.

Fig. 3. Shows duodenum drawn up and everted. The arrow denotes the site of the entrance of the common duct into the duodenum.

Hertle (2) recognized the futility of this procedure in treating ruptures of the third portion but condemned Dambrin's (3) suggestion to go between the root of the mesentery and the mesocolon and suggested that we should lengthen Kocher's incision along the outside of the hepatic flexure of the colon and turn it up with the duodenum — a procedure that is surely possible but rather extensive. In my second case of duodenal rupture, owing to the presence of fat necrosis in the retroperitoneal tissue, I suspected an injury of the pancreas or probably a rupture of the duodenum since the experimental work of Richter (4) had demonstrated that a simple perforation of the duodenum could give rise to such a change. The region of the pancreas showed no involvement. I, therefore, turned the transverse colon and omentum upwards and elevated the back by means of a kidney elevator. This brought into the field the transverse duodenum, the hepatic flexure of the colon, and the root of the mesentery. An incision of the peritoneum between the reflected colon and duodenum freely exposed the third portion of the duodenum. By tearing the peritoneum, the entire retroperitoneal duodenum was freed and brought into the field from the entrance of the bile-ducts to the jejunal angle without hæmorrhage or injury to any structure. That one can suture a considerable tear in the gut, I can bear personal witness.

On looking up the literature, I find that Dambrin in a *Paris Thesis* upon rupture of the intestine, suggested, on anatomical grounds, the possibility of going between the root of the mesentery and the mesocolon, and Winiwarter (5) fell upon almost the same procedure as myself in treating a ruptured duodenum during the last year. I did not have the benefit of it, however, as it was not published until after my own experience.

The exposure can be made quickly and absolutely without hæmorrhage or the injury of any vital structure. I have found it of especial value in those cases in which we must decide whether a patient is suffering from a chronic pancreatitis, a carcinoma of the head of the pancreas, or a stone in the di-

verticulum of Vater. Here, instead of the laborious and inexact method of palpation from above, we can in less than a minute turn up the colon, nick the peritoneum, and separate the edges with the index finger and raise the duodenum with the attached head of the pancreas from its bed. The entire head of the pancreas can now be held in the hand, and in case of doubt a section removed for microscopic examination. The duodenum can now be rolled up and the site of the entrance of the common gall-duct examined from behind. The mobilization and exposure is so free that in thin individuals, at least, it would seem that a stone could be removed if it were thought advisable, although I have not had an opportunity to test it. In the obese, owing to the excessive retroperitoneal fat, the procedure is somewhat more difficult, although I have used it for examination with satisfaction. Also a word of warning should be given against violent traction or handling, since it is well known that any extensive manipulation of the duodenum and pancreas is conducive to shock, possibly because of their close association with the sympathetic plexus. It has seemed to me that the cases where I have exposed the duodenum in the manner described have suffered more shock than is usual after a laparotomy, but we must remember that these patients with long-continued jaundice are poor surgical risks at best and any procedure upon them should be conservative and limited to the least possible trauma.

After the examination is complete, a single fine catgut suture closes the rent in the peritoneum.

BIBLIOGRAPHY

1. KOCHER. Mobilisuring des Duodenum und Gastroduodenastomie. Zentralbl. f. Chir., 1902, ii.
KOCHER. Operative Surgery, 1911.
2. HERTLE. Über stumpfe Verletzungen des Darms und des mesenteriums, Beitr. z. klin. Chir., 1907, liii, 257.
3. DAMBRIN. Recherches sur l'analomie pathologique et le traitment des lésions de l'intestine dans les contusions abdominales. Thése, Paris, 1903.
4. RICHTER, H. M. Perforating Duodenal Ulcer with Fat Necrosis. Quart. Bull. Northwestern Univ. M. School, xii, 131.
5. WINIWARTER. Deutsche Ztschr. F. Chir., 1913, cxiii.
6. SUMMERS, JOHN EDWARD. The treatment of Posterior Perforations of the Fixed Portions of the Duodenum. Ann. Surg., Phila., xxxix, 727.

# THE PITUITARY GLAND IN ITS RELATION TO EPILEPSY

BY GEORGE C. JOHNSTON, M. D., PITTSBURGH

INVESTIGATIONS of the pituitary gland have been made post-mortem in epileptics by a number of men, but the conclusions have been unsatisfactory and but few changes were found in the gland. It is quite probable that these investigators have been so concerned in the microscopic study of the gland structure that they may have overlooked other things of importance.

Nature considers the pituitary of such importance in the animal economy that she has located it in a most inaccessible and strongly fortified position, lying in a deep depression in the roof of the sphenoidal sinus, in a bony pit roofed over with a strong prolongation of the dura and protected from pressure by the anterior and posterior clinoidal processes. The situation of this gland is unique and, arguing from analogy, its importance is equal to the care that has been exercised for its protection.

Interest in the brilliant work of Dr. Harvey Cushing, formerly of Johns Hopkins and now of Harvard, and an observance of the few cases of pituitary diseases in which epilepsy was an important part of the symptom-complex, stimulated us to an examination of the pituitary region in every case of epilepsy obtainable, especially those in which no symptoms of pressure in the region of the pituitary (as evidenced by changes in the eye-grounds and visual fields) were present.

We were very soon compelled to divide the cases into primary cerebropaths, pituitary tumors, and epileptics. In the majority of cases, little if any information was obtained

by röntgenography of the first class, but there remained a second class of patients who, with an uneventful history, no injury, the ordinary children's diseases, previous good health, somewhere between the ages of 15 to 35 began to have attacks of petit-mal gradually increasing in severity and frequency.

As our investigations began to include this type of cases, we noticed decided departures from our conception of the normal in the topography of the sella turcica (see plates). These changes were rarely found in the types of chronic epileptics, but were found with a regularity that gave rise to intense interest in the second class of cases above described, namely, those who, with previous good histories, between the ages of 15 and 35 began to develop epilepsy. The changes consisted for the most part in an overgrowth of the anterior and posterior clinoidal processes, which, in addition to an increase in area and length, are slowly folded over and down upon the pituitary gland, enclosing it within a bony basket. In addition to this process, which evidently is one requiring a considerable length of time for its accomplishment, there is very often noticeable a decided difference in the size of the pituitary fossa and, therefore, of the gland itself. The fossa is thus largely or completely roofed over in some cases, illustrations of which will be shown, in which the shadows of the anterior and posterior clinoidal processes not only meet but overlap. The frequency with which this condition has been found in this class of cases is quite striking. At first we were inclined to look upon it as a mere interesting anatomical deviation, but when it reached a point where we were almost able to prophecy, from the history of the patient and a physical examination, the practical degree of roofing to be expected in a given case, we were forced to attach some importance to this abnormality. Cushing and others had long previously shown that hypopituitarism was accompanied by epilepsy or epileptiform seizures.

In addition to this overgrowth of the clinoidal processes, a large proportion of the cases show distinct increase in density in the bony tissues forming the roof of the orbits, the sphenoidal sinus, and the ethmoidal cells. In quite a number of cases, the sphenoidal cells are decidedly blocked with newly-formed bony tissue. This condition resembles, to a marked degree, the appearance of the skull in general acromegaly and has been interpreted by us in accordance with a theory advanced by Doctors McKennan and Henninger as a localized acromegaly. Other investigations along this line will be published later.

Our investigations to date total some one hundred cases of epilepsy in which a very high percentage show one or more of these features.

The pituitary with its stalk, the infundibulum, lies within the sella covered over by a prolongation of the dura, the diaphragma sellæ, through an opening in which the infundibulum connects the gland to the brain. The anterior lobe is large and embraces on its median aspect the smaller posterior or cerebral lobe. The anterior lobe is of a glandular character, histologically, and is surrounded by a thick, loose, fibrous capsule. The posterior lobe is smaller and softer, and to it directly comes the infundibulum. This portion of the gland, histologically, is rather nervous than glandular tissue, especially during infancy and youth; but it is not with the pituitary as an adjunct to the nervous system that we are concerned, but rather with the possibility of interference with the posterior lobe of this gland in its functional relation. The anterior lobe resembles rather the thyroid, and is rather kidney-shaped, receiving its blood-vessels and the infundibular stalk in the hilus much as does the kidney. It is said to increase in size until about the thirtieth year. Its blood supply is rich, and its function in connection with the growth of the body is now, thanks to the researches of Cushing and others, so well understood that we need not discuss it at this time. In some animals the pituitary stalk persists during life and is continuous with the epithelium lining the mouth, passing through a canal in the base of the skull, and a condition resembling this is occasionally met with in man, where a canal in the sphenoid leads from the sella turcica to the base of the skull

and contains a prolongation of the hypophysis. I have one such plate.

It is thus seen that the pituitary, owing to its peculiar location, may be encroached upon to a considerable degree by any hyperostosis of the posterior or middle clinoidal processes, since the tough dural roof completes its enclosure by bone; and it is our belief that the deviations here to be shown, whether they are to be considered as anatomical deviations or as the result of a more or less rapid bone deposit due to an inflammation (of the etiology of which we are yet ignorant), may cause a hypohypophysial condition of which the epileptiform attacks are merely the symptoms. Cushing has shown that interference with the posterior lobe will cause a hyperexcitability of the cerebral cortex, and we believe that the cases shown belong in this class wholly or in part.

I quote from Cushing on the pituitary as follows:

"One may reassemble the data in regard to the possible relation of hypophysial insufficiency to epilepsy as follows:

"1. Horsley, it will be recalled, in his first experimental hypophysectomies in the canine, observed no post-operative changes whatsoever in the condition of the animals. They were, however, used subsequently as subjects of cortical stimulation, and he noted that the motor cortex was unusually excitable.

"2. As already stated, we have observed a tendency to epileptiform convulsions in a number of our animals kept for long periods after partial hypophysectomy — animals that ultimately exhibited symptoms which we attribute to glandular insufficiency.

"3. The study of a series of cases of hypophysial disease in man has shown that epilepsy — a symptom unobserved in states of hyperpituitarism — is a frequent accompaniment of clinical conditions in which an insufficiency of the gland is manifest. Moreover, that the brain, under these circumstances, is possibly overexcitable, is suggested by the number of individuals in whom gustatory attacks have occurred under the influence presumably of a direct local irritation of the adjacent uncinate cortex by the enlarged gland.

"4. As is well known, epilepsy is a frequent sequel of cranial injuries. In certain types of injury, as the common bursting fractures of the base, the pituitary body is prone to be damaged.

"5. If, as we believe to be the case, the posterior lobe secretion normally enters the cerebrospinal fluid and thus comes to be in solution in a fluid which subsequently bathes the cortex, it is possible that its diminution from hypophysial disease or injury may unfavorably affect the activity of the cortical cells. On this basis it is conceivable that a local scar which involves, or a tumor which presses upon, a given area of the cortex, may prevent the access to the cells of a substance which is essential to their functional stability.

"6. Many individuals, supposed to be suffering from so-called genuine or essential epilepsy, present manifestations of a nutritional disorder — a tendency to adiposity and a high sugar tolerance, coupled with a lowered temperature and pulse rate — closely akin to the constitutional state which characterizes hypophysial deficiency. In some of these individuals the administration of hypophysial extract has served to moderate the seizures from which they previously suffered."

The pituitary, in common with other ductless glands, in order to functionate requires a blood supply. We are justified also in believing that it has periods of activity followed by repose (functionally speaking). During the periods of activity, it is engorged with blood and an increase in its size and tension occurs.

A pituitary that is not roofed in has a decided advantage over one that is completely encircled and enveloped in a bony cell. Moreover, in some of our cases it is hard to determine why the gland has not been completely cut off by a slow encroachment of the process above the gland, and in one case, where there seems to be a calcareous degeneration of the gland going on, we suspect that this has happened.

We believe we are justified in asserting that the gland is handicapped by being encroached upon, its circulation is hampered and its physiological activity mechanically interfered with and diminished, and that the epileptoid seizures are wholly or in part the result of the deprivation of the animal economy of those substances necessary to metabolism and produced within the pituitary. If this hypothesis is founded on any truth or fact, then a patient suffering such epileptoid seizures (due wholly or in part to such deprivation) should be partially or completely relieved and made free from the seizures if it were possible to supply artificially that which is lacking and that of which the patient is deprived, due to the partial or complete failure of normal supply from the pituitary. Two of my colleagues have found that the administration of the pituitary extract by the mouth is of distinct value in the specific class of patients under discussion; not to the extent that it permits of the immediate substitution of pituitary extract in lieu of the well-tried bromides, but rather that the exhibition of pituitary extract in gradually in-

creasing doses with bromide, followed by a slow withdrawal of bromide and the persistence of pituitary administration, is followed by very interesting results. At first it was thought that the proper thing to do was to cease the bromides and substitute therefor the pituitary extract. Here, however, we were soon taught that the administration of bromide is followed by immediate effect, whereas the administration of pituitary extract requires a considerable length of time before its beneficial effects are manifested. There elapsed, therefore, an interval during which the patient had no bromide and had not yet begun to experience the beneficial effects of the extract, during which time, if such time were allowed to elapse, severe epileptic seizures were very likely to occur. From this it seems that the combined method of administration is the one to employ, followed by the slow withdrawal of the bromide to a minimum.

Such a report as this can be considered merely as a preliminary one. The proof of such an hypothesis will require a very much larger number of cases than have yet been examined. The examination of any such case, to be of value, must show distinctly and clearly the sella turcica and the processes. If the processes do not show, that in itself is evidence that the case is probably one of hypopituitarism due to hypophysial struma, with enlargement of the gland and pressure atrophy of the processes. Neither, by any means, are all cases of epilepsy developing between the ages of 15 and 35 or 40 due to encroachment upon the pituitary. In some of these cases there will be found, instead, a very small pituitary, but not encroached upon.

Cushing has devised an ingenious method whereby the pituitary region can be reached and removed by a sellar decompression. Such an operation, however, is employed for the relief of intercranial pressure. What we now wish him to devise is an operation for the removal of one or both clinoidal processes in these cases of choked pituitary. If such an operation can be devised and performed before the process has been too long active and before the gland has suffered long from its imprisonment, it may be that such procedure will be followed by brilliant results. Such an operation, however, will tax the skill and ingenuity of any surgeon.

We make no claims for the truth of the hypothesis comprised in this preliminary report, since to establish such a claim will require that much more work be done than has been done. We present it with the hope that it may stimulate the interest of the men of this society, who alone, in this country, are capable of carrying on such an investigation. These cases are widely scattered, and no one man can hope, in a reasonable length of time, to see enough of them to make his single opinion of great value. If, however, the members of this society will carefully ray the pituitary fossa of every epileptic other than those so-called chronic, practically congenital epileptics, keeping a record of the history of the onset of the attacks and the age of the patient, etc., within another year we should have a large number of such cases to report, and the truth of the matter could be easily established. Personally, the thing works out with monotonous regularity, due to the fact that Drs. McKennan and Henninger, and also Dr. Mayer, are trained and experienced neurologists, who select the epileptics who are examined.

# THE PRODUCT OF A HOSPITAL[1]

By E. A. CODMAN, M. D., Boston

THE object of this address is to stimulate thought on and discussion of the standardization of hospitals. I take it that the word standardization implies a general movement toward improving the quality of the products for which hospital funds are expended. As a rule standards are raised by stimulating the best — not by whipping up the laggards. It is for this reason that I am selecting some of the best Philadelphia hospitals as hopeful material. Their weaknesses are less than those of other cities, so that what may appear to be local criticisms will be found to apply to all the great general hospitals in the cities of the United States.

In various manufacturing businesses I imagine that it is not difficult to render an exact account of the product of a factory. So many dozen tin cans, cakes of soap, toothpicks, or pickled pigs' feet are readily figured up. With educational institutions and hospitals the problem is very different. The statement of the number of patients treated or of students graduated gives but a fraction of the products of such institutions. What, then, are the products of a large hospital, whether in the forms of healed wounds, healthy babies, faithful nurses, promising young surgeons and physicians, or in the more abstract forms of original ideas on pathology or treatment, model methods of administration, or such intangible things as enthusiasm and ideals?

It would be supposed that in the annual reports of hospitals some account of their products would be found. To a certain extent this is true, but often much of the material in an annual report is but a mere account of money subscribed and the proportionate amounts which are spent on the different departments.

I recently collected the annual reports of many of the large hospitals in America and endeavored to compare them, with a view, if possible, to obtaining some definite form of report which would be available for all such institutions and which would enable those interested to compare the work done by the different ones. Unfortunately, many of the things which seemed to me of the first importance are scarcely mentioned, if at all. I am proud to say that the report of the institution with which I am connected (the Massachusetts General Hospital, of Boston) I find to be as full and instructive as the report of any hospital in the country; but even that carefully prepared volume is not wholly satisfactory.

For the sake of promoting discussion, I will briefly attempt to give an account of the products of this hospital for the year 1912, taking part of this information from the annual report, and mentioning some of the more important things which the hospital has accomplished but which are not stated in the report. I hope that in the discussion which is to follow we may learn some method of proportioning these different products in terms of relative value.

The Massachusetts Hospital has 320 beds and a large out-patient department or dispensary. Six thousand eight hundred and ninety-six patients were treated in the wards and 22,639 in the out-patient department. Similar gross facts can be obtained from almost every hospital report, but when an attempt at comparison of the figures alone is made, some ratio must be established between the number of beds in the institution, the number of patients, and the per capita expense. With these figures we may form a sort of bed unit, corresponding to foot-pounds in physics, which would show the product of the institution in the number of beds, the patients treated per bed, and the price per patient per day. The number of patients treated and the per capita expense are some indisputable facts which appeal to minds trained for business problems, as those of conventional hospital trustees. They feel that, having made their arrangements so that a single bed may be used by twenty-odd different patients at a reasonable

[1] An address read before the Philadelphia County Medical Society, May 14, 1913.

expense in the course of a year, the question of cure or benefit is entirely in the hands of their medical brethren, and of little consequence to them or to those who support the hospital. Really the whole hospital problem rests on this one question: What happens to the cases? In this connection I want to speak of the work of Mr. Michael H. Davis, the business manager of the Boston Dispensary, who has recently called public attention to a new viewpoint in hospital and dispensary management. He has applied the modern principles of business efficiency to institutional work by analyzing certain groups of cases coming to the Boston Dispensary. He is able to eliminate a certain proportion of visits as useless. From the point of view of treatment, there are certain diseases, for instance, gonorrhœa, which obviously cannot be essentially improved by one visit. These visits appear in the annual report, but cannot really be considered as products of the institution; they correspond to the badly made articles in a factory which have to be thrown away. Such a principle applied to the product of a hospital bed might show that twenty-odd cases treated by one bed in one institution might correspond to a far smaller number in another institution. To answer this question, one must turn to the portion of the report on the classification of diseases and the results obtained by each.

Leaving aside the number of patients treated and the question of whether or not these patients were benefited, there are certain products of the institution which are of great value, seemingly irrespective of the result to the patient. The most obvious is the instruction of medical students receiving clinical experience as assistants or as graduates or undergraduates. At the Massachusetts General Hospital, 61,000 student-hours of instruction were given to 163 students in the lecture rooms or wards of the hospital, besides many hours of instruction at the Harvard Medical School, in which data obtained from the hospital in the form of photographs and clinical experience of the professors were utilized. This estimate does not include our graduate or summer-school teaching. At first sight this instruction seems proportionate to the number of patients, but practically this is far from being the case.

In hospitals where the proportion of visiting surgeons and physicians to the number of patients is smaller, far less instruction can be given. Clinical treatment, as well as clinical instruction, requires time. The product of the hospital in the education of the medical student is by no means proportionate to the number of patients. There are much larger hospitals at which no such enormous amount of time is utilized for medical instruction. Besides the number of students and student-hours, the quality of the instruction must also be considered. Personally, I believe that the system of paying the instructors of a medical school by giving them an opportunity to do advertising as consultants is a vicious and false system. It puts too great a strain on weak human nature.

One might say that the instruction of the students is irrespective of the results to the patients, but let us suppose, in surgery, for example, that all the operations which have been watched by these students have been misdirected efforts at the cure of disease, and the students have learned to do something which is not worth while and does not really improve the patient. The product of the hospital in this case, even as regards student instruction, would be nil — even worse than nil. We are, therefore, referred again to the classification of disease and the results to the patients, because a student would naturally wish to receive his instruction at a hospital where the treatment was shown to be of benefit to the patient. We may, then, say that the product of the hospital in medical education, like the product in the number of cases treated, depends on whether or not the cases are well treated.

Another product is the number of nurses graduating, and this product varies too, not only in number but in quality. At the Massachusetts General Hospital 34 nurses were graduated. I can easily show you that this list means much more than the number 34 by the following table, which shows 60 positions filled by the superintendent of nurses at the Massachusetts General Hospital from her recent graduates.

10 superintendents of hospitals.
7 assistant superintendents of hospitals.
5 superintendents of training schools.
3 assistant superintendents of training schools.
5 night superintendents.
11 heads of departments.
4 instructors.
5 medical social workers.
5 private school nurses.
2 medical school missionaries.
1 anæsthetist.
2 district workers.

Thirty-four nurses graduating to fill such positions as these means a product of a very fine quality, but after all is it not important that the nurses should gain their experience in carrying out good treatment, and are not nurses wanted at other institutions because they come from a clinic where the technique and the results of treatment are superior? Again we are referred to the classification of diseases in the table of results.

The Massachusetts Hospital also furnished the community with a product of 18 trained house surgeons and physicians. These men have gone into our community and others to practice the forms of treatment which they have learned at the Massachusetts General Hospital. Will they do good in the new positions which they occupy if the basis of their education was founded on opinion which ignored the real results of the treatment of their cases?

In 1912, 53 ladies were either paid or voluntary helpers in the social service department. The social service worker is really a therapeutic agent — she forces the prescriptions of the physicians down the throat of the careless or refractory patient. She blindly believes that the prescription will do good. Does it? I must confess that I have doubts as to whether the actual treatment carried out by these social workers during this past year has given real benefit, and yet I consider Dr. Cabot's exploitation of the social-service idea one of the most important products of our institution in the last decade. But its real usefulness will only come when, by scientifically tracing our cases, we have shown that our prescriptions are really efficacious. As Dr. Cabot himself says: "In hospitals without an expert and conscientious medical staff it is almost useless to establish social service. Every item of our social works gets its value from the accurate physical diagnosis with which we start or to which we try to contribute, and from the rational plan of the treatment in which we are asked to assist. If the medical diagnosis is faulty, the social work based on it may do serious harm."

To my mind, ridden as it is by the end-result hobby, the social service department should be of greatest value as an instrument of recording the results of treatment.

From the more or less direct hospital products which we have been considering, we now come to the less tangible ones.

In 1912, 115 papers were printed by the staff of the Massachusetts General Hospital. All these papers are more or less products of the hospital — most of them entirely so. In considering this portion of the subject, we must include the widening effects of past contributions and the accumulating thunder which next year will appear in print. Dividends of honor are still coming to the hospital from Bigelow's work on the hip-joint and Fitz's work on appendicitis, and we may hope that other epoch-making papers are now in process of construction.

The publication of medical and surgical papers by members of our profession is a very interesting phenomenon. We are like boys throwing pebbles into a pond. Some stones fall without even a splash, producing only that peculiar sucking sound which we used to call "cutting an egg." Others splash, wake up the pond for an instant, and send out more or less widening circles, which fade away entirely or leave little ripples which nobody recognizes as belonging to the original splash. Occasionally some apparently dull boy, when our backs are turned or when we are busy watching our own circles, throws in a huge rock which starts an enormous wave, and we all throw in a stone in a hurry and try to think that we made the wave ourselves. As much of truth as there is in our own efforts coincides with and reinforces the wave until even its author is appalled by its size.

Think of the modest Würzburg professor and the tidal wave which has come from his

recognition of the previously unknown X-rays! Think of what that discovery has meant to almost every branch of science, and especially to medicine and surgery! There is to-day hardly a disease in which the X-ray is not of benefit, either for diagnosis or therapy. Think of the number of radiologists who hurried in to take some some credit! Surely the product of that Würzburg laboratory is difficult to measure!

Such epoch-making contributions, however, are not the ordinary products of our hospital factories. The ordinary paper is merely an additional stone thrown to swell the progress of the wave. And in fact, some stones only do good by counteracting some other smart boy's big splash. Perhaps this negative product, after all, is one of the important functions of a hospital. But when we once realize the thousands of patients the world over who have benefited by the work of Fitz, and the millions more who have been helped by the lesser contributions toward the knowledge of almost every disease, which have come from the less famous workers at the Massachusetts General, we must confess that the good done to the 6000 patients whom we annually treat is nothing in comparison.

There remain many other by-products of a hospital, some of which are important. To my mind the influence of the hospital on the standards of medical practice in the community is of greatest importance.

Great institutions are checks on the frailties of human nature. To a great institution like the Massachusetts Hospital, men may give their effort toward the truth, their aspirations for what is best, but they cannot contaminate it except briefly with their personal frailties. The great surgeon or physician may be avaricious, mean, ill-natured at home, jealous, even immoral or drunken; but when he appears for public duty at the hospital he must at least assume the appearance of virtue and efficiency. With his reputation behind him he may gull the public at his office or in his private hospital, but in the public institution the trained watchful eyes of his assistants, consultants, and nurses are ever on him. Youth's earnestness, hopefulness, and outspoken admiration mean much to him. To hold his position he must travel and read, at least somewhat, to keep up appearances, and the habit of self-examination thus formed reacts on his private practice. The laity realize our temptations to bluff, but they do not realize how much they are indebted to hospitals for discouraging this tendency to bluff, and substituting a habit of bluffing so carefully as not to be caught. Just as in politics the self-seeker must exploit some popular demand to attain a coveted position, so in a modern hospital the physician or surgeon must gain some of his prestige by his advancement of medical science. As Professor James said in his "Essay on Habit," even agnostics may in time become religious if they form the habit of going to church every Sunday.

I therefore place the raising of the standard of professional honor — or shall I say accuracy — in a community as one of the most important by-products of a great hospital. And yet this very point brings up a most important question which can be expressed thus: Does a community get the best service by allowing as many as possible of its busy practitioners to brush themselves up by superficial work at the hospital, or by putting the hospital in the hands of a few paid men who shall set an example for the practitioners to follow? To put this proposition in other words, should each great city have one or more institutions organized like a private business institution, or should the big city institutions be run as they are at present, with unpaid staffs on a seniority system?

The answer to this question brings us again to the fundamental point in the whole hospital problem.

*We must formulate some method of hospital report showing as nearly as possible what are the results of the treatment obtained at different institutions. This report must be made out and published by each hospital in a uniform manner, so that comparison will be possible. With such a report as a starting-point, those interested can begin to ask questions as to management and efficiency.*

AUTHOR'S NOTE

A set of statistics had been prepared comparing the mortality at a certain semi-

private hospital of 200 beds with that of four of the best general hospitals in America, having a total of 1200 beds. These statistics were obtained from published reports. They clearly showed that the semi-private hospital not only did many more operations, but that the mortality was much lower, especially in some of the more difficult branches of surgery. The question was then raised as to the reasons why a 200-bed surgical hospital so excelled the four great general hospitals having, together, six times the number of beds.

Besides the many obvious reasons, such as the fact that many beds must be used for medical cases; the depraved and debilitated character of municipal pauper populations; the obligation which rests on charitable hospitals to make no selection of cases; the dependence on subscribed funds; the fact that the visiting physicians and surgeons are unpaid, etc., there remain other questions more directly related to the organization of the surgical department. These questions were prepared to be graphically presented by the following questions and answers to be exhibited on successive lantern slides:

---

Is it because busy men whose living is made *outside* the hospital control the operative material?

Which surgeons operate on the most difficult cases — those best qualified, or does seniority, chance, or the calendar decide such questions?

Should not honor belong to seniority, rather than opportunity to operate?

Should not a surgeon do his routine operating as an elastic young man, and his special work and private practice in later life, when his capacity for mere manual improvement has ceased and his experience counts?

If we had been allowed to begin to operate earlier, would we not be willing to let others do so?

What good does a staff surgeon do (except to himself) by doing simple operations which his juniors can do as well?

---

In answer to similar unpleasant questions, the surgical staff of the Massachusetts General Hospital did this:

They reorganized in such a way that each active member of the staff undertook to give special study to some difficult class of cases, and in return the hospital assigned to each member all the cases of that group.

The result has been that the mortality in these groups of cases showed a great improvement, and our community has at its service a few men qualified to do each of these difficult operations.

---

Does the semi-private institution have less Waste Products?

For example, each day the patient is delayed by (1) slight or grave wound sepsis; (2) the surgeon being detained by private practice; (3) preventable complications such as bronchitis, phlebitis, cystitis, sinuses, etc.

Or, for example, all the days the patient was in the hospital —

If his hernia soon recurred.

If some of his gall-stones were not removed.

If his operation was unnecessary or inappropriate.

If his appendix was removed instead of his renal calculus.

If he died without a good excuse.

---

To whose interest is it to minimize these Waste Products?

Should the superintendent, the trustees, or the junior or senior visiting surgeons attend to it?

At any rate it would not be a popular task.

---

The Massachusetts Hospital has answered these questions by establishing an end-result catalogue. By means of this catalogue and two hours a week a superintendent, a trustee, or a senior surgeon can keep himself accurately informed as to what is happening to 6000 cases a year.

---

For whose *primary interest* is it to have the hospital efficient? For:

1. The patient who seeks relief.
2. The public, who support the hospital and in return expect a high standard of knowledge on the part of their own private physician or surgeon.
3. The hospital itself, which as an institution has an individuality of its own.

Who represents or acts for these interests?

Strangely enough, the answer is: No one, it is for the *interest* of no one. It is the *duty* of no one.

---

For instance:

For whose *interest* is it to investigate what is the *actual result* to the patient operated on?

For whose interest is it to insist on the resignation of incompetent old Doctor So-and-so, who is one of the best fellows that ever lived?

Who will warn the largest annual contributor that his agreeable classmate, Doctor So-and-so, is totally unfitted to remove his stomach?

Who is to say that a hospital is doing more harm than good in surgery, and that its funds would be better expended as an institution for nervous diseases?

---

There is a difference between interest and duty.

You do your duty if the work comes to you, but you don't go out of your way to get the work unless it is for your interest.

Let us make attention to the medical and surgical efficiency of the hospital the *duty* of some one.

---

But if we think too much about *mortality*, shall we not fail to do desperate operations which we should do?

Who should attempt these desperate operations — the man anxious to make a reputation, or the man who has made one?

---

The operation of gastrectomy for cancer of the stomach is a good example.

A mortality even as high as 50 per cent is justifiable, because unfavorable as well as favorable cases should be done. But what surgeon doing private practice has reputation enough to undertake such a mortality? To be successful with this operation a man should have great surgical skill, special training on animals, abundant opportunities to do the operation, and security of reputation, so that his private practice will not be ruined by the necessarily high mortality.

Which of us with cancer of the stomach would not be willing to take a 50 per cent chance in skilled hands?

---

The Hospital Section of the American Medical Association, the American Hospital Association, and the Clinical Congress of Surgeons have each appointed a Committee on the Standardization of Hospitals.

The Carnegie Foundation has agreed to conduct an investigation.

Are *you* ready?

SUGGESTIONS

That each prominent hospital in this city appoint an efficiency committee consisting of a trustee, a member of the staff, and a superintendent.

That these committees inquire into the efficiency of their own hospitals, with a view to answering the questions which are sure to come from the Carnegie Foundation.

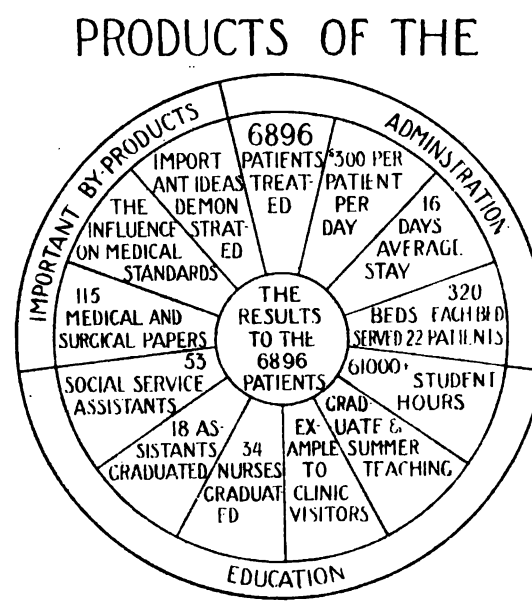
That an example of this kind set by the Philadelphia hospitals would lead to the establishment of similar committees in other cities, and eventually to a national organization representing the patient, the public, and the individual institutions.

---

A graphic representation showing that all the radial facts depend on the central idea.

Beginning at the top and referring to the center we see that the *number* of patients *treated* is of no consequence unless they were benefited.

The cost per patient per day shows pure




extravagance if none of the patients were benefited; but if all the patients were cured it would be a record for economy.

The average days per bed or average patients treated per bed per year are likewise affected by the ratio of success to failure.

Of what use are 61,000 student-hours and all efforts to instruct nurses, assistants, and graduate students and visitors, if we do not know what results we are obtaining? The value of the instruction is proportionate to our success in treatment.

If 115 papers are written on individual statements of the results of their writers' observations or treatment, will they not carry more weight to the professional public if the authority of the hospital in its annual report endorses the writers' statements by the presentation of the actual figures of patients cured or relieved?

In a similar way, all the important by-products depend in the end on demonstration that the patient can be helped.

# INCRUSTATIONS OF THE RENAL PELVIS AND URETER

By JOHN R. CAULK, A. M., M. D., Saint Louis
Genito-Urinary Surgeon to Out-Patients, Washington University

SINCE reporting to the American Association of Genito-Urinary Surgeons, last year, a case of calcareous incrustation around one of the renal papillæ, I have encountered three cases exhibiting a somewhat similar pathological process, which I desire to present for your consideration.

The whole question of stone formation and of calcareous deposition in the genito-urinary tract, as well as in the body tissues in general, is surrounded by such an atmosphere of confusion that much attention and interest have centered on it. Many hypotheses have been proposed and many debates created.

The pathological picture of the case above referred to seemed to warrant the conclusion that the incrustation of the renal papilla was secondary to a papillary necrosis. In reviewing the opinions of other men on the subject of calcareous deposits in the body tissues, it is found that the great majority are of the opinion that necrosis is the prime factor in such formations.

Delafield and Prudden, in their chapter on "Calcareous Infiltration," say that in this condition there is a deposition, either in the cells or intercellular substance, of larger or smaller granules composed chiefly of phosphate or carbonate of calcium. Pathological calcification usually, if not always, occurs in parts which are dead or in a condition of reduced vitality as a result of antecedent abnormal processes which, as a rule, are of inflammatory nature. Fatty degeneration of the cells frequently precedes calcification.

Liek has found in his experiments that calcareous deposition in the kidney is markedly hastened by circulatory disturbances. Regarding circulatory disturbances Maschka says that heart disease can have an influence in the production of stone. Liek concludes that a combination of necrosis and circulatory embarrassment is necessary for calcareous deposits; while Aschoff lays stress especially on urinary stasis and the excessive secretion of certain salts.

Ebstein calls particular attention to the rôle played by colloids. In stone formation he believes that colloids form the ground substance, which is absolutely essential, no matter what the composition of the stone. He was able to produce, in animals, renal, ureteral, and vesical calculi by feeding the animals on oxamide, which he believes acts as a toxic agent on the epithelium of the urinary tract, causing degenerative changes, and that the degenerated epithelial cells impregnated with oxamide form the nucleus of the stone.

Ehrlich considers the presence of iron in the tissues to have an important bearing on calcareous deposits.

Kumita believes that infection plays the important rôle in incrustations. This was contradicted by Tuffier.

Mueller says that, as a result of primary necrotic inflammation of the kidneys, salts are formed around the tissues which are injured, and incrustations and stone formations ensue.

Litten proved that hæmorrhagic infarcts and tissues with arterial anæmia possess a high affinity for calcium. Many authors believe in a specific diathesis. Some claim that patients suffering with gout, rickets, osteomalacia, and spinal caries have a special disposition to stone formation. This is greatly questioned by others.

Among the various diseases which have been proposed as having an etiological influence in stone formation have been typhoid fever, diphtheria, cholera, auto-intoxications, icterus, eclampsia, gout, and diabetes. The poisons which may predispose to this condition are cantharides, corrosive sublimate, chromates, chlorates, oxalic acid, aloin, glycerine, phosphorus, arsenic, and vinylamine. By chronic poisoning with the latter, Levaditi was able to produce a papillary necrosis and secondary incrustation with salts. Thus it seems that the majority of observers agree that the essential process for calcareous infiltration is necrosis.

[1] Read before the American Association of Genito-Urinary Surgeons, Washington, D. C., May 7, 1913.

The question next arises, Why are these salts deposited in areas of necrosis?

The rationale of the deposition of salts in the damaged cells and tissues is not clear, and much work is being centered on the problem. In infiltration in various tissues of the body the salts are derived from the blood and lymph, but in the genito-urinary tract they are evidently derived from the urine, which, it is highly probable, is hypersaturated with them on account of a special diathesis.

The presence of phosphorus in the affected tissues, the existence of fatty acids with which the calcium may form insoluble soaps, and proteids capable of uniting with calcium, have all been advanced as determining factors. This whole question was admirably presented by Wells in his Harvey lectures.

The comparative rarity of primary incrustations in the upper urinary passages seems to me to make the report of the four cases not superfluous.

CASE 1. Obstructive calcareous papillitis — retention cyst of the kidney. This case was reported in detail in the *Transactions* of this association last year, and in this report the history will be given in abstract.

Patient, male, 46 years of age, farmer. Complained of a dull aching pain in the right side beneath ribs, occasional reflection along the ureter into the scrotum; also had symptoms referable to the posterior urethra and prostate.

*Family history.* Father died of cancer.

*Personal history.* There is nothing of importance in his personal history with the exception of typhoid fever at the age of 21.

*Present illness.* His present trouble started about a year and a half ago with an acute colic in the right side below the costal margin, which radiated along the ureter into the scrotum. Since this time there have been many similar attacks. Coincident with this there were increased frequency and slowness of urination, slight hesitancy and diminished force of the stream, and hæmaturia. The attacks of pain above described were exceedingly severe in the beginning, but were quieted by local applications. He did not pass stone or gravel. The pain in the last attacks were not sharp, but of an aching, throbbing character. Upon examination it was found that the urinary distress was due to a subacute prostatitis and posterior urethral engorgement, which promptly cleared up on treatment of these organs. The throbbing pain in the right side, however, persisted. An X-ray picture at this time showed a small crescentic shadow in the region of the right renal pelvis. Ureter catheterization procured perfectly normal urine from both sides, with the exception of an occasional red blood-cell from the right. Phthalein test appeared on the right side in nine minutes, on the left in eight minutes. First hour output on the right side, 15 per cent; second hour output, 12 per cent. First hour on the left side, 18 per cent; second hour, 13 per cent. On the presence of the shadow and the finding of a few blood-cells from the centrifugalized urine, a lumbar nephrotomy was done, and the following interesting pathological picture was obtained. A cyst the size of a small walnut was found in the lower pole of the kidney, corresponding to one of the pyramids, the papilla of which was incrusted with a calcareous material, which later was found to be composed principally of calcium phosphate. As this paper has its bearing only on incrustations, a description of the cyst and of the kidney in general will be omitted.

A pathological report of the papillary lesion given by Dr. Opie is as follows: The sections were preserved in 4 per cent formalin and the material was decalcified with 5 per cent nitric acid. Blocks were mounted in paraffin and stained with hæmatoxylin and eosin. The section of the papilla with the incrustation showed that the tip of the papilla was covered with a homogeneous material which took a deep blue stain of decalcified material. The tissue in immediate contact with this mass has undergone hyaline degeneration. In this hyaline area, as the calcified mass is approached, numerous minute calcified granules are seen. Deeper into the substance of the papilla the tissue is loose in texture and contains numerous small blood-vessels. There are also occasional collections of lymphoid cells. It was thought that this condition was due to a primary necrosis of the papilla, with a secondary deposition of calcium phosphate.

CASE 2. Incrustation of calcium phosphate on the posterior wall of the renal pelvis. Patient 35 years of age, male. Complained of aching pain in the right kidney region and blood in his urine.

*Family history.* Negative.

*Personal history.* The only diseases of importance were diphtheria at the age of 18 and acute tonsillitis in 1909. Following this the patient began to suffer with pain in the right kidney region and occasionally with pain in the right side lower down, for which he sought relief at the hands of a Chicago surgeon who removed his appendix, which was said to be gangrenous. Shortly after this he had another similar attack, and since then he has had attacks with much greater frequency. In October, 1910, during the course of one of these attacks, he passed blood in his urine. Since then he has passed blood with most

of the attacks of pain. I saw him in November, about one week after one of his sieges.

*Examination.* Patient was a slender, anæmic individual, but nothing abnormal was found in his general physical examination.

*Cystoscopic examination.* Catheter passed easily. No residual urine. Bladder capacity normal; both ureteral orifices normal in appearance. Ureteral catheters passed easily on both sides and the urine showed the following: Right side, many w. b. c., few r. b. c. and colon bacilli, albumin and casts; left side clear, no albumin, few r. b. c. Phenolsulphonephthalein, given subcutaneously in a 6-mg. dose, appeared on the right side in 12 minutes; first hour output, right side, 32 per cent. Left side appeared in 12 minutes; first hour output 35 per cent. X-ray picture showed a shadow in the region of the right kidney pelvis.

*Operation.* Right lumbar nephrotomy; kidney freed and delivered and bisected with silver wire. No stone was found in the kidney. By invaginating the renal pelvis it was found that a brownish incrustation lined the greater part of the posterior wall. A sponge was packed below and this calcareous material shelled off from the wall of the pelvis, to which it was very adherent, and in one place the pelvic wall was torn during the removal of the material. The tissue under the calcareous material was very granular and friable. After the incrustation was completely removed the pelvis was irrigated thoroughly. Kidney closed in the usual manner. Small drain to kidney. Wound closed with interrupted catgut. Following operation there was a slight urinary leakage for three days. This promptly ceased, and the patient made an uninterrupted recovery. Since then he has been perfectly free from pain, has gained weight, and the urine is perfectly clear.

Whether the necrotic pelvic wall was secondary to the calcareous deposit, or whether the changes in the pelvic wall were primary and responsible for the deposit, cannot be definitely stated, but from the pathological findings of the other observers it would seem that the calcareous deposition was secondary to the changes in the renal pelvis, similar to what was found in the papilla in Case 1.

CASE 3. Incrustation of the upper ureter. Patient, a woman 32 years of age, whose complaint was intermittent attacks of colicky pain in epigastrium and an occasional soreness in right upper back.

*Family history.* Negative.

*Personal history.* No acute illness, no chronic cardiac pulmonary or gastro-intestinal disorders. Menstrual history normal. Has borne two children; both deliveries normal. There was never any trouble during her pregnancies.

*Present illness.* Two months after first child was born (eight years ago) she was suddenly seized with cramps in epigastrium region, which lasted for several hours. Pain did not radiate, and as she described it "stayed in the pit of her stomach." Since that time she has scarcely passed a day without having a similar pain. These attacks have borne no relation to food or to constipation. Has never had any chills, fevers, sweats, or jaundice. There has been absolutely no urinary frequency, pain, or hæmaturia. Two years ago she had her appendix removed for the trouble, but without relief. Since that time she has been observed by numerous men, who have presented various diagnoses. Among the diagnoses may be mentioned gall-stones, cholecystitis, gastric and duodenal ulcer, pyloric spasm, pelvic inflammatory disease, and others. During this time she has had about thirty X-ray pictures and fluoroscopic examinations with bismuth meals. Her husband, who is a friend of mine, desired that I determine the condition of her kidneys. On inquiring into her case, I found that she had absolutely no symptoms referable to her kidney regions with the exception of an occasional ache in right upper back. She had never passed any stone or "gravel" to her knowledge.

*Examination.* In spite of all the trouble and suffering, she was very well preserved. There was nothing found in the general abdominal examination. No tenderness anywhere in the abdomen. Urine perfectly clear, but on centrifugalization an occasional w. b. c. and some calcium oxalate crystals were found. No trace of albumin. Cystoscopic examination showed a perfectly normal bladder. The right ureteral orifice was slightly larger than usual, but presented no evidences of an inflammatory reaction. Left catheter passed easily to the renal pelvis; right catheter was obstructed three inches lower than the left. Urine from the left side negative. From the right occasional w. b. c. and many calcium oxalate crystals. As I thought it possible that her condition might be due to an intermittent hydronephrosis, both pelves were injected with 10 per cent collargol. The left pelvis was normal. On the right side I was unable to get the collargol into the pelvis. Immediately after withdrawing the catheter, patient was seized with a pain similar to the ones above described, which lasted about two hours and required morphia. Following this attack she voided urine which contained many particles similar to crushed eggshell, but of a yellowish-brown color. Several days later an X-ray picture was taken and showed a faint shadow about one and one-half inches long, evidently in the upper ureter. A shadowgraph catheter was passed and another picture taken. The catheter obstructed exactly at the lower margin of the shadow. At this time the catheter was manipulated freely, following which she passed a considerable amount of this granular material. Since this time she has never had an attack of pain, has gained a great deal in weight, and feels perfectly well. After the third treatment

catheter passed easily to the pelvis, and an X-ray picture showed that a shadow was still present but considerably smaller. Encouraged by the relief obtained by the ureter catheter, I attempted to remove this deposit by means of the catheter. After ten manipulations, extending over a period of three months, in which the patient had been perfectly free from pain, an X-ray picture showed no shadow. After each catheterization I injected the upper ureter with 10 per cent argyrol. The functional test with phenolsulphonephthalein, given after the third manipulation, yielded the following: Time of appearance, eight minutes on both sides. Right side, first hour, 19 per cent; second hour, 10 per cent. Left side, first hour, 22 per cent; second hour, 10 per cent.

A résumé of the important facts of this case is as follows: (1) Reflection of pain to the epigastrium with no radiation along ureter and no urinary distress; (2) marked amelioration after the second ureter catheterization; (3) numerous diagnoses of different abdominal conditions; and (4) the removal of the incrustation by means of the ureter catheter.

In the beginning I was at a loss to know whether to advise operation, with the removal of the calcareous deposit, or to attempt the procedure which was finally adopted. It impressed me that, having a normal kidney and a long incrustation in a narrow canal, with evidently an inflammatory ureter back of it, the chances of subsequent stricture would be great, with a probability that a nephrectomy would have to be the final issue. Hence it seemed that even if the incrustation could not be removed, if the patient could be relieved of pain and the ureter kept patent this would be the most desirable. I solicit the opinion of this association on this particular point.

CASE 4. Male, 52 years of age, complained of an aching pain in right side beneath costal margin.

*Family history.* Negative.

*Personal history.* Gonorrhœa as a young man; no complications. Typhoid fever in early adult life; otherwise negative.

*Present illness.* Five years ago patient had an attack of colic in his right side, radiating into the scrotum and penis, associated with urinary frequency and pain, followed by the passage of a small irregular calculus. Since that time he has had three similar attacks, each time passing a small jagged stone. General health has been good since his last attack. No chills, fever, or sweats, and no urinary distress. Three days before I saw patient he began to complain of an aching pain in the right side beneath the ribs, with a feeling "as though his sides were being blown out." There was marked diminution of urinary secretion, and for 24 hours patient had been nauseated, vomited, and suffered with headache; also slightly irrational. Temperature ranged from 100° to 101.5° F. During the previous 24 hours had voided but three ounces of urine.

*Examination.* A large man, flushed, slightly irrational; marked tenderness in right kidney region with kidney considerably enlarged.

*Cystoscopic examination.* Catheter passed easily; two ounces of very concentrated urine withdrawn. Bladder capacity normal. The left ureteral orifice normal in appearance; right ureteral orifice œdematous and pouting. Ureter catheter passed easily on the left side, but on the right side was obstructed one-half inch within the orifice. On manipulation small particles escaped by its side. With the catheter in place, sterile water was injected into the ureter for the purpose of washing out some of the contents. The urine from the left side was clear and contained no pus cells or bacteria but many hyaline casts. No urine could be collected from the right side. Patient was put on rectal salt solution, purged, and given large quantities of water to drink. X-ray picture showed a very faint shadow about three-fourths of an inch long low down in the ureter, corresponding to the location in which the catheter was obstructed. The following day a shadowgraph catheter was passed into the orifice, and after much manipulation passed by the obstruction. Large quantities of urine were drained through the catheter, and patient was relieved of his pain. The urine was loaded with calcium oxalate crystals. After the kidney was thoroughly drained, catheter was again moved to and fro in the lower ureter and argyrol injected. Two days later a similar procedure was undertaken. The material which passed was not only sandy, but there were many long, flat spicules, similar to those in Case 3. This patient was advised to keep himself under close observation and to have the catheter passed at frequent intervals. However, he failed to take the advice given, and I have not seen him since last August; but he writes me that he is feeling perfectly well and has no trouble.

It is to be observed that the incrustations in the cases above referred to occurred in different parts of the upper urinary tract, establishing no special point of predilection. Two of the cases exhibited a definite pathological background for the calcareous deposit—an inflammatory lesion of the renal pelvis in one case, and of the papilla in another. In the ureteral cases not coming to operation the fundamental lesion could not be determined; but in the light of the other two cases, it is safe to assume that such a lesion was present in these also and served as

the etiological factor for the calcareous implantation. In the two cases in which the incrustations were examined chemically it was found that they were composed of calcium phosphate with traces of calcium oxalate. In the two ureteral cases, I was unfortunate in not securing enough of the material for chemical analysis. In Case 3, through a mistake, the nurse did not save the total urine as I had directed, and in Case 4 I forgot to leave instructions for the urine to be retained and strained. However, the urine in these two cases contained calcium oxalate crystals and the dry material presented a gross appearance similar to the other cases. Thus it seems evident that the deposit in all four cases consisted of calcium. As possible etiological contributors to the incrustation in the four cases, typhoid fever in two cases, diphtheria in two cases, and tonsillitis in one case may be mentioned. In the last mentioned case, immediately following the attack of tonsillitis, the first renal storm was ushered in. It seems highly probable that there had been an acute pyelitis.

Case 4 (incrustation of the juxtavesical ureter) had passed previous calculi, which must undoubtedly have caused inflammatory changes and necrosis of the lower ureter. Case 3 (upper ureteral incrustation) presents a negative history as to the passage of calculi. It is possible, however, that in her initial attacks calculi may have passed which produced changes in the upper ureter and afforded a nidus for calcareous implantation. On the other hand, it may be that there had been a local circulatory disturbance. Three of the cases were males and one was a female. The symptomatology of three of the cases suggested a kidney lesion and presented nothing of importance. Case 3 (upper ureteral incrustation) presents an interesting feature, in that there were practically no symptoms referable to the kidney with the exception of a very occasional soreness in the right back. The reflection of the acute pain to the epigastric region, occurring in paroxysms of great frequency, which suggested to many able clinicians and surgeons some intraperitoneal lesion, is noteworthy. It is possible that many of the pains simulating gastric and duodenal ulcers and gall-stone colics may have their origin in lesions in the upper ureter associated with an intermittent hydronephrosis.

Concerning the diagnosis of these incrustations, each of the cases within the pelvis was diagnosed as renal calculus, and the true diagnosis was established only at operation. The two ureter cases were diagnosed as incrustations based on the following facts: (*a*) Faint X-ray shadow similar to Cases 1 and 2; (*b*) the passage of crushed eggshell-like material following manipulation with the ureter catheter; (*c*) the passage of the catheter through the obstruction, relieving the patient of symptoms, the X-ray shadow still persisting; and, finally, the gradual disappearance of the shadow, as in Case 3, by manipulation with the ureter catheter. These points seem to differentiate a true incrustation from a calculus or sandy impaction.

The treatment of such cases depends upon their location. Incrustations around the papillæ or in the renal pelvis should be removed by nephrotomy, provided they are productive of symptoms which demand operative intervention. The ureteropelvic juncture should be blocked to prevent any particles from getting into the bladder. After the removal of the incrustation the pelvis should be thoroughly lavaged. Post-operative treatment is similar to that of an ordinary stone case, with the exception that the pelvis should be injected with argyrol several times during the first few months. Pyelotomy seems inadvisable in such cases, as it will not provide sufficient exposure to insure the complete removal of all of the calcareous material. With incrustations in the ureter, our object is to do as little damage as is possible to the ureter in attempting their removal, so as to lessen the liability to post-operative stricture. In the removal of an ordinary calculus, the calculus can either be milked back into the dilated part of the ureter and thence removed through a small incision, or it can be moved in loco through a small incision, being extracted endwise; whereas with incrustations these procedures cannot be adopted. It would be necessary either to open the ureter throughout the length of the deposit in order

to shell off completely all of the incrustation, or possibly to open the ureter by a small incision above the incrustation, and by means of a small blunt curette to scrape it off from the ureteral wall. This latter procedure does not impress me as being safe. With such procedures I am inclined to think that the chance of subsequent stricture would be extremely grave. For this reason, I believe that in such cases the removal by means of the catheter is the method of choice; at least it should be given a trial before more radical measures are attempted.

BIBLIOGRAPHY

ASCHOFF.
DELAFIELD and PRUDDEN.
KUMITA. Mitt. a. d. Grenzgeb., xx, H. 4.
LITEN. Ztschr. f. klin. Med.
MUELLER. Langenbeck's Arch. f. klin. Chir.
ROSENBACH. Mitt. a. d. Grenzgeb., 1911, xxii.
WELLS. Harvey lecture.

---

# GASTRIC SARCOMA[1]

## REPORT OF A CASE

BY H. J. HARTZ, M. D., PHILADELPHIA
Pathologist to Gynecological Department, Jefferson Medical College Hospital

PRIMARY gastric sarcoma has been considered a comparatively rare disease, but many cases described as carcinoma at time of operation have probably been sarcomata. This is evidenced by the fact that on microscopical examination, a true sarcoma is diagnosed where the gross specimen was typical of cancer.

Mikulicz and Kausch (1) contend that five to eight per cent of all primary tumors of the stomach are sarcomata. Hosch (2) has collected 102 cases of primary gastric sarcoma, while Fenwick (3) in a careful study of the literature in 1900, believes that but 53 of the 60 recorded cases are true sarcoma of the primary type.

In Fenwick's series, 62 per cent of the sarcomata were of the round-celled type. This form of growth occurs, generally, as a dense infiltration of the stomach wall near the pyloric end, but differs from cancer in that it does not cause stenosis of the pylorus. In about one-sixth of the cases the growth involves the entire stomach, invading both œsophagus and duodenum. The spindle-celled sarcoma is less common. It commences in the submucosa and the mucosa may remain intact for a considerable time. They are most often circumscribed and pedunculated and grow to be quite large; Cantwell (4) removed one weighing 12 pounds.

Of the rarer forms, myosarcoma and angiosarcoma are the most important. Cysts may form from hæmorrhages or necrotic processes in the central parts of the tumor.

Sarcoma of the stomach may occur at any time of life, from infancy to extreme old age. Among the 70 cases where the age was recorded, Hosch found 27 patients under 40 years, 26 over 50 years and 17 between 40 and 50 years.

The symptoms are similar to those of carcinoma: progressive loss of flesh with debility and anæmia. Free Hcl. is usually absent and lactic acid present as in cancer; pain is common. The history of a long standing dyspepsia and of pyloric obstruction, which is usual in cancer, is seldom met with in sarcoma. Hæmatemesis is frequently present in the round-cell type, while in the spindle-cell variety all gastric symptoms may be absent. Metastasis in glands, distant organs and in the skin are prone to occur in the former.

The duration of life in the round-celled growth is 15 months; in the spindle-cell, life may be prolonged from 24 to 32 months.

Surgical treatment of gastric sarcoma, so far as the immediate effect of the operation is concerned, has met with considerable success. The solid tumors are especially favorable to extirpation, particularly when pedun-

[1] Read before the Southeast Branch, Philadelphia County Medical Society, November 15, 1912.

culated, but in all cases it is desirable to remove the portion of the stomach wall from which they spring. The most recent contribution on the surgical treatment of this subject is made by E. von Graff (5).[1] The case reported is stated to be the fifty-sixth on record in which the stomach was resected on account of a primary sarcoma. The outcome is known for only three of the eight patients who survived the operation or its complications among the twelve treated by radical resection of the growth. Among them is Dock's (6) patient, known to be in good health four years afterward. Of the 28 patients treated by resection of an exogastric sarcoma, the outcome is known in only 19 cases, and only 3 of these patients were free from recurrence after a three-year interval.

The case that I am about to report was operated upon by Professor E. E. Montgomery at Jefferson Medical College Hospital.

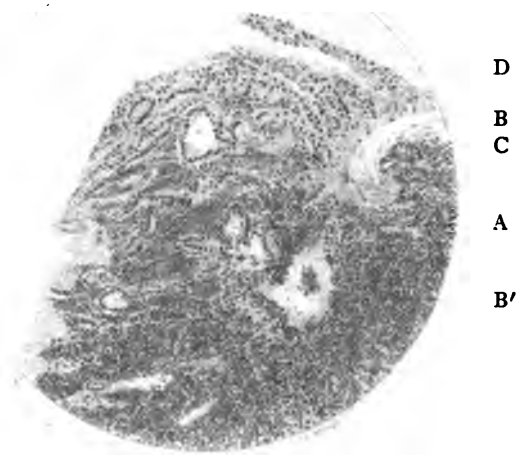
C. S. B., 41 years of age, white, born in United States. The family history was negative. The patient led an active outdoor life, was never sick until present illness. The present illness commenced about two months prior to coming under observation. Indigestion and intense pain in the region of the stomach was complained of occasionally. Had never vomited, but would feel greatly nauseated after partaking of a meal.

The physical examination showed the patient to be a well developed, fairly well nourished adult male. Chest, heart and lungs were normal. Nothing abnormal could be elicited in the abdomen on palpation, but percussion revealed extreme tenderness in the upper abdomen. The hæmoglobin was 85 per cent; red blood-cells 4,680,000; leucocytes, 25,000.

The operation consisted in an incision four inches long, along the right rectus muscle as far as the umbilicus; the stomach was covered almost entirely with small hæmorrhagic areas and was somewhat infiltrated. The condition was diagnosed as malignant, but, as too large an area was involved, it was deemed best to close the abdomen without attempting a radical operation. The pancreas and the gastrocolic omentum showed secondary involvement. A small section of the omentum was removed for microscopical study.

The specimen removed measured 8 by 3 by 2 cm., weighed 4 gms., of reddish color, and somewhat friable; incised surface showed smooth, grayish areas. Portions of this mass were fixed in alcoholic-bichlorid, embedded in paraffin and stained in the usual manner. Under the microscope a great increase of small round-cells was noted, which overshadowed the reticulum. A germinal follicle was occasionally noted and the capsule showed no marked thickening. In some areas the cells were so placed as to suggest the possibility of a small round-celled sarcoma. A diagnosis from this section was made of hyperplastic lymph adenoid tissue, suggesting a possible small round-cell sarcoma. Patient died 16 days after operation.

[1]Wien. klin. Wchnschr., 1912, June.




Small round-cell sarcoma of stomach. A, remnants of gastric tubules in sarcomatous tissue; B, B′, blood-vessels; from C to C′, quadrant of sarcomatous tissue; D, partially necrotic mucosa; above C′, necrotic area on surface.

The post-mortem findings showed the anterior wall and lesser curvature of the stomach to contain a firm mass of grayish color. The glands at the lesser curvature of the stomach were found to be enlarged. The omentum showed infiltration and adhesions and the head of the pancreas showed similar changes. The post-mortem diagnosis was carcinoma of the stomach.

Microscopical examination revealed a small round-cell sarcoma, and not a carcinoma as the post-mortem findings indicated.

REFERENCES

1. Mikulicz and Kausch. System of Practical Surgery, edited by Bergmann and Bull, 1904, iv, 369.
2. Hosch. Deutsche Ztschr. f. Chir., 1907, xc, 98.
3. Fenwick. Cancer and other Tumors of the Stomach, London, 1902, p. 274
4. Cantwell. Ann. Surg.. Phila., 1899, xxx, 596.
5. von Graff. Wien. klin. Wchnschr., 1912, xxv, 991.

# DEPARTMENT OF TECHNIQUE

## THE PATHOGENESIS AND TREATMENT OF HERNIÆ OF THE LINEA ALBA[1]

By ALEXIS V. MOSCHCOWITZ, M. D., New York City
Visiting Surgeon, Har Moriah Hospital; Associate Surgeon, Mount Sinai Hospital

ALL herniæ that occur in the midline of the abdomen, with the exception of those that occur at the umbilicus, are grouped collectively under the name "hernia of the linea alba." They are far more frequent above the umbilicus than below; this is due to the greater width of the linea alba above the umbilicus. Longitudinal bulgings of the linea alba are occasionally called herniæ, but they are not herniæ in the true sense of the word, because there is no defect in the transversalis fascia. These bulgings are caused by a wide separation of the recti within their sheaths.

Because of their greater frequency above the umbilicus, these herniæ have also been called "epigastric" herniæ. Epigastric herniæ vary greatly in size; some may be no larger than a pea, others again may attain the size of a fist. The larger sizes are very likely to occur in the immediate vicinity of the umbilicus; in fact it is still a question whether these are not really umbilical herniæ. The greater majority, however, are very small; in fact many are so small that it is questionable whether they are herniæ in the true sense of the word. In most of the cases that I operated, I have failed to convince myself that, prior to the operation, there existed a true hernia, with a true sac.

*Surgical anatomy.* The linea alba, placed in the midline of the abdomen between the two recti muscles, is an aponeurotic structure formed by the union of the sheaths of the recti on either side. It is broader above the umbilicus than below; and behind is in relation with the peritoneum, but separated from it by the transversalis fascia.

Fig. 1 shows, schematically, not only the formation of the linea alba, but also its relationship to the transversalis fascia and peritoneum. As in other parts of the abdomen, the blood-vessels run between the peritoneum and the transversalis fascia. Normally the linea alba above the umbilicus is perforated by numerous blood-vessels. These vessels must of necessity perforate the transversalis fascia; and in so doing, receive the customary outward prolongation of the transversalis fascia. At the level of one of these vessels, therefore, the linea alba should be represented schematically (Fig. 2).

The space between the posterior sheath of the rectus and the transversalis fascia is very narrow. Indeed, the space is purely a hypothetical one. Furthermore, if it is considered, as I have shown upon a previous occasion, that at the point where the vessel pierces the transversalis fascia there is an outward prolongation of this structure, even this hypothetical space disappears, because at this point the linea alba and the transversalis fascia are joined. I have explained at some length an apparently very trivial point; but this point is of great importance, enabling us to explain certain peculiarities of an epigastric hernia.

This hole in the transversalis fascia, through which a vessel passes to the surface, is a weak spot, and it requires merely an increase in the intra-abdominal pressure for the nearest subjacent structure to be forced into it.

I now wish to call attention to another anatomical point, whose importance has not been recognized; namely, that in the midline of the abdomen, or rather slightly to the right of the linea alba, there is attached the falciform ligament of the liver. This ligament is composed of two layers of peritoneum, enclosing considerable adipose tissue. Anteriorly this adipose tissue is in close juxtaposition with the transversalis fascia of the abdomen at the linea alba.

A diagrammatic horizontal cross-section of the linea alba at the point where it is pierced by a blood-vessel can, therefore, be illustrated as in Fig. 3.

Given a hiatus in the transversalis fascia made by the piercing of a blood-vessel, it is manifest that the first tissue that can be forced through this opening would be the properitoneal fat enclosed in the falciform ligament.

[1] Read before the Surgical Section, New York Academy of Medicine, November 7, 1913.

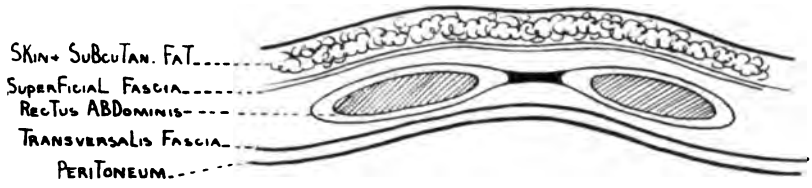



Fig. 1. Diagrammatic cross-section of anterior abdominal wall, illustrating the formation of the linea alba.

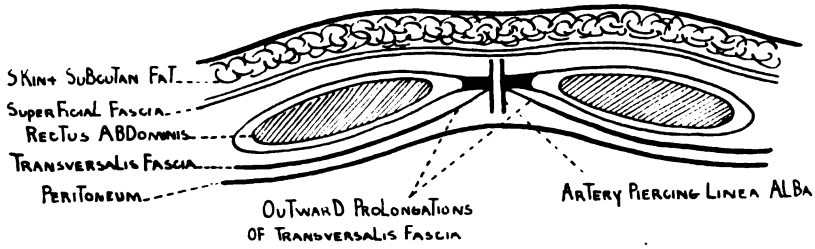



Fig. 2. Diagrammatic cross-section of anterior abdominal wall, illustrating the linea alba, at a point, where it is pierced by a blood-vessel. Note outward prolongation of the transversalis fascia.

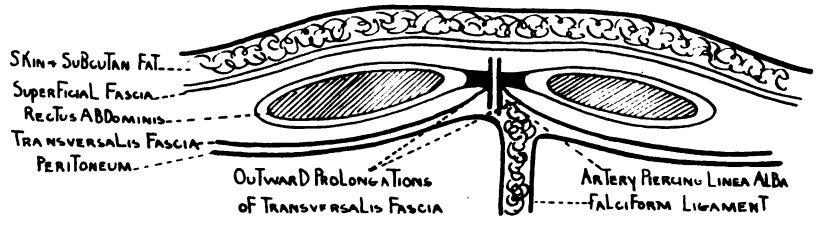



Fig. 3. Diagrammatic cross-section of anterior abdominal wall, illustrating the linea alba at a point where it is pierced by a blood-vessel, and showing also the formation of the falciform ligament of the liver.

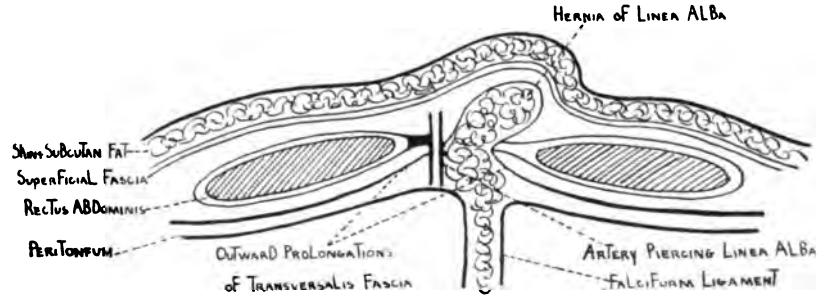



Fig. 4. Diagrammatic cross-section of a hernia of the linea alba, illustrating its coverings.

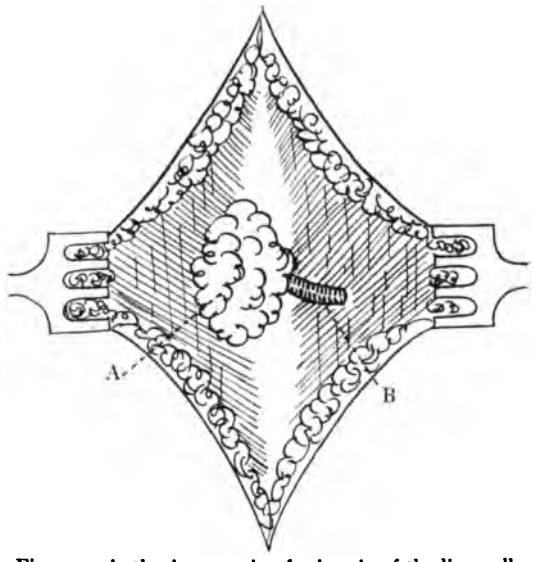



Fig. 5. Author's operation for hernia of the linea alba. A, properitoneal fat continuous with falciform ligament. B, artery piercing linea alba.

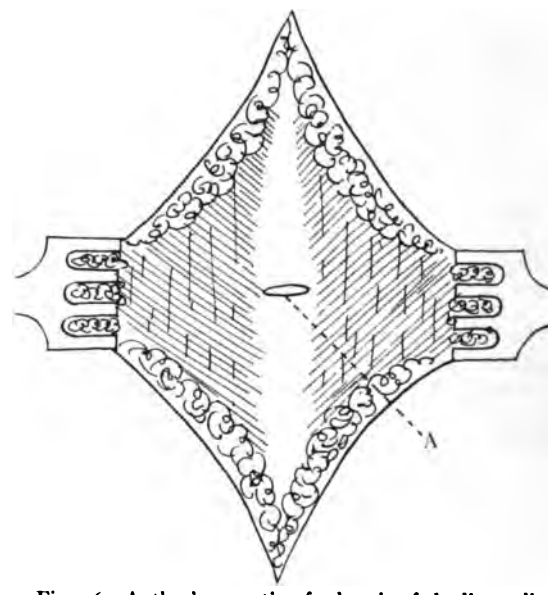



Fig. 6. Author's operation for hernia of the linea alba, showing the transverse slit in the linea alba. A, slit in linea alba.

An ordinary epigastric hernia would, therefore, have the appearance shown in Fig. 4 in a diagrammatic cross-section.

The holes in the transversalis fascia are very small, and the fascia and the other component parts of the linea alba are strong and inelastic; these facts explain why epigastric herniæ, so-called, rarely attain a very large size.

As a result of my observations upon epigastric herniæ I am able to assert unequivocally that I have never failed to isolate a distinct large vessel coming through the hiatus, accompanied by a larger or smaller piece of fat, directly continuous with the fat of the falciform ligament.

There is never a distinct hernial sac present. Indeed, if one works distinctly in the midline, or a little to the right of it, he will never even enter the peritoneal cavity; a very puzzling circumstance to those who are not acquainted with the pathological anatomy of these herniæ. If one insists on opening the peritoneum, this can be done only along the left margin of the hernia.

In the symptomatology of these cases, the gastric distress has been commonly explained as due to the presence of the stomach; but no one, as far as I am aware, has actually observed the stomach in such a hernia. Furthermore, as in most instances there is not even a hernial sac, I do not see how the stomach can even enter. I believe, therefore, that this symptom is more rationally explainable by the simple dragging upon the fat and peritoneum of the falciform ligament.

*Treatment.* The operation usually carried out for these herniæ is as follows: The linea alba over the site of the hernia is split. Immediately the previously mentioned nodule of fat is encountered. The surgeon observes the thin enclosing, shiny covering of the fat, and mistakes it for the peritoneum. He incises this covering, and after a rather summary examination, he at once assumes that he is dealing with adherent omentum. In order to orient himself still better in regard to the true condition of things, he begins a dissection with a view to further opening the peritoneal cavity, which he finally accomplishes after much labor. Of course, he finds nothing; he, therefore, complacently sews up the freshly opened peritoneum and linea alba.

Ever since I have been convinced of the correctness of my observations, I have practiced the following simple procedure. A small vertical incision is made over the center of the so-called hernia. The skin and subcutaneous fat are divided and retracted, thereby exposing a lump of fat (Fig. 5). Search is now made for the blood-vessel previously mentioned. Usually it is found upon the left side of the protrusion, and this vessel is caught and ligated. The fat is now teased apart, in order to be absolutely convinced that there is no true sac. The shreds

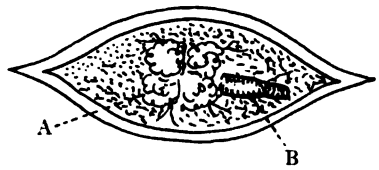



Fig. 7. Author's operation for hernia of the linea alba. The vessel and fat have been ligated, and the stumps pushed back into the transverse slit in the linea alba. A, properitoneal fat ligated in four sections. B, ligated artery.

of fat are now ligated, to obviate a secondary hæmorrhage. The ligatures are placed close to the bottom of the hole in the transversalis fascia (Fig. 6 and 7). The stumps are now pushed back into the hole, and the latter closed with one or two stitches (Fig. 8). Finally the skin is closed in the usual manner.

On theoretical grounds, it may be argued that the procedure just described is faulty, because of the possibility remaining, that the fat is merely reduced into the space between the transversalis fascia and posterior sheath of the rectus. In order to combat this argument, I refer to my previous observation, represented in Fig. 2. It is seen that, owing to the outward direction of the transversalis fascia, there is a blending of the transversalis fascia and sheath of the rectus; therefore, the stumps of fat and ligatures cannot be pushed anywhere except into the properitoneal space. The sutures which close up

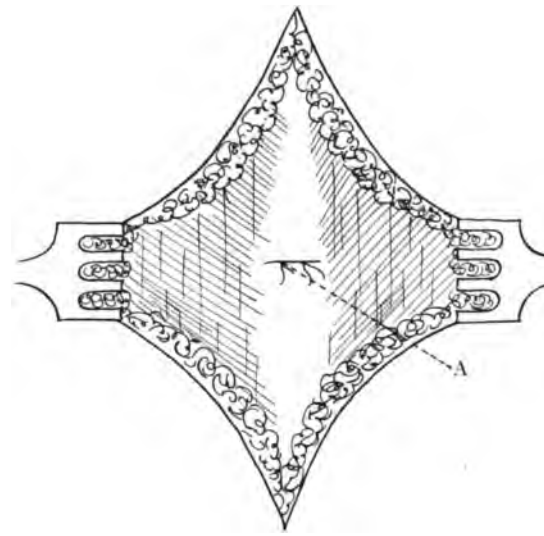



Fig. 8. Author's operation for hernia of the linea alba. The transverse slit in the linea alba closed by two sutures. A, slit in linea alba closed by two sutures.

the hole grasp all the component parts of the linea alba at that particular point, namely linea alba plus transversalis fascia.

Strangulation is exceptionally rare in epigastric herniæ, but that it can occur is amply proven by an interesting case reported by Hotchkiss.[1]

[1] Ann. Surg., Phila., liv, 78.

# ARTHROTOMY OF THE HIP

By EDRED M. CORNER, M. C., London, England
Surgeon and Lecturer to St. Thomas' Hospital and to the Children's Hospital

As in all other departments of surgery, the introduction of methods of asepsis and modern technique has opened up to surgeons fields of work of which our professional ancestors never dreamed. Such a change has come over operation on the hip-joint. Formerly disease, sepsis, and surgery destroyed all function in the hip-joint, even in cases regarded as successful. Now, not only can surgery do much to stay the ravages of disease, but as sepsis is practically absent the surgeon can retain the function of the joint or even make a new joint. Whilst previously the healing in successful cases ended in ankylosis, the modern surgeon makes a new joint. The increase of the usefulness of the surgeon in procedures on the hip-joint has naturally led to inquiries amongst them as to the way in which they can do their work better, that is to say, what is the least maiming, most exposing, and most quickly closed method of operation to be used by the surgeon to deal with disease and deformity of the hip-joint?

First, there is the ordinary anterior incision described in the text-books, conducted between the sartorius muscle and the tensor fasciæ femoris, the gluteus minimus and the rectus femoris. All know that this incision gives a very partial view of the neck of the femur and a very imperfect one of the head of the femur and of the acetabulum. As such, it may be dismissed from further consideration, being used only for opening a septic joint.

Posterior incisions, such as Kocher's, give better exposure, and, being introduced when wound drainage was of the greatest importance, the situation of the above incision was ideal for that drainage when the patient was lying on his back. But both anterior and posterior incisions, though good for opening the hip-joint, were deficient in giving a good exposure for the conduct of further measures unless complicated by much muscle-division, such as led to bleeding into the wound and the spoiling of the joint afterwards for functional purposes. Indeed, the anterior and posterior incisions into the joint were adequate so long as surgeons did little more than open the joint. Criticisms on and corollaries to such methods, e.g., the exposure of the hip-joint by an anterior incision curving backward above the trochanter and dividing the gluteus minimus, tensor fasciæ femoris, and the gluteus medius in part, can be passed over. Good exposure of the joint was obtained at the expense of much muscle-cutting, bleeding, and suturing to close the wound. It was not till 1905 that that ingenious surgeon, J. B. Murphy, invented a method of access to the hip-joint in order to enable him to carry out an arthroplasty. In this place I would direct your attention only to the method of access to the joint, and urge its application to many operations besides that of arthroplasty.

A U-shaped incision is made with the concavity upward and the convexity directed toward the knee. The incision is begun just below the anterior superior spine of the ilium, is carried across the lower part of the trochanter, and up to a place on the buttock not quite so high as the incision is in front. The skin and fascia are raised in a flap nearly as far as the upper ends of the incisions. The anterior border of the gluteus minimus is defined and an elevator thrust backward under it and beneath the tip of the great trochanter. The lower fibers of the gluteus maximus to the femur must be separated from their attachment.

In this place I would refresh your memories as to the muscles attached to the great trochanter. These are five: the gluteus minimus, the gluteus medius, the pyriformis, the obturator internus and gemelli, and the obturator externus. The top of the great trochanter projects upward as a bony process, and must be sawn off so that these five muscles remain attached to it and yet so that the saw-cut does not traverse and weaken the neck of the femur. Of these muscular attachments, attention need only be given to one, that of the gluteus minimus. The lower fibers of the muscle extend down the anterior surface of the great trochanter to meet the upper fibers of origin of the vastus externus. The tip of the trochanter is sawn off obliquely, so that the saw emerges into the angle between the neck of the femur and the trochanter just below the digital fossa; first, press the elevator under the gluteus minimus down firmly into the angle between the great trochanter and the neck of the femur and saw toward but just below it from the lower attachment of the gluteus minimus. The elevator is set free as the tip of the trochanter

Fig. 1. The incision.

is detached. With a hook the detached fragment of the trochanter is retracted upward with the muscles attached to it and the neck of the femur and hip-joint exposed, covered only by fibrous tissue and bands of Weitbrecht. Being within easy sight the joint may be opened, or a bony disarticulation with the ilium freed, without difficulty. Moreover, the head of the femur may be only temporarily disarticulated by adducting the leg, to enable the surgeon to examine and remove disease present in the acetabulum. If the joint requires exposure for the suture of a fracture of the neck of the femur or separation of the femoral epiphysis, a screw can easily be inserted into the detached femoral head from the trochanter via the neck of the femur.

The operation is quickly concluded by attaching the detached tip to the trochanter by a single suture of iodine catgut inserted through the bone. I have not found it worth while to do the reattachment with a screw. The wound, especially in its posterior part, is in a situation where it can easily be infected in the nursing of the patient after operation. This is the case in all posterior incisions for the exploration of the hip; though ideal for drainage, it is undesirable to drain them. In the operation described, the soft parts are separated and not cut, except the capsule of the hip-joint. Therefore, when combined with careful hæmostasis, there is no need to drain the wound in these cases. The quicker the wound is sealed the less the chance of skin infection. I, therefore, approximate the skin edges by four or five rectangular sutures of iodine catgut and coapt the cut margins with a continuous suture of ten-day catgut, with the stitches inserted close to the cut edges of the skin and close together. By these means the closure of the wound is quick and sound; and it is sealed by the continuous skin stitch practically at once. The leg is put up in a splint in the abducted position. The presence of the splint and the character of the skin wound make it awkward to take out these stitches, therefore the use of absorbable sutures in the skin is suggested, since they need never be removed.

There is a further point in the closure of these wounds, namely, what measures can be taken to insure that ankylosis between the femur and the pelvis will not occur. The handiest and ever-present resource is to place in the acetabulum a flap of fat, fascia, or muscle, covering the head of the femur similarly. But the dissection and formation of such flaps is apt to lead to the oozing of blood and lymph from the cut-surfaces. Hence I have covered the head of the femur with Baer's membrane (chromicized pig's bladder prepared for Dr. Baer of New York). This allows

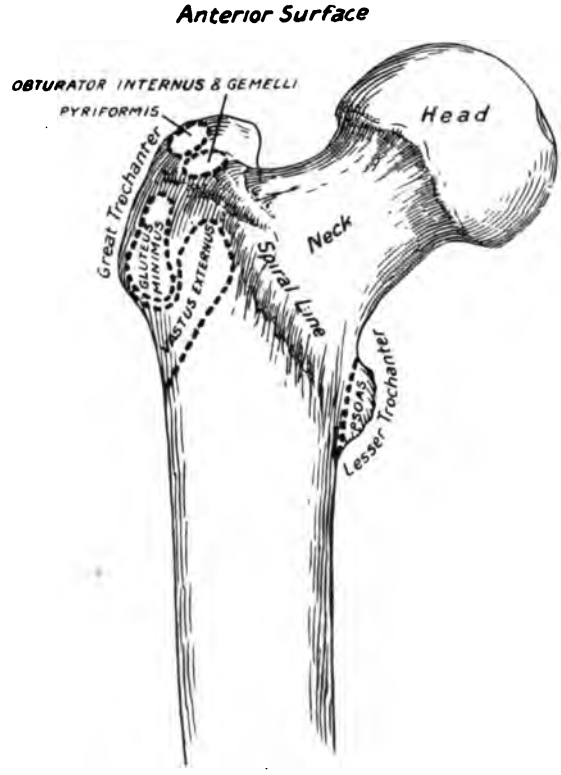



Fig. 2.

plenty of time to elapse for the wound to become soundly healed and painless before movements need be attempted. This is a very great advantage. It is asserted that as long as 100 days may be allowed to elapse before movements are started.

Before referring to the records of cases appended to this paper,[1] I would like to say that one great tendency of modern surgical technique is to operate more and more by the aid of the sense of sight, and to operate less and less by the aid of the sense of touch. Sight cannot convey infection, but touch can and does very easily. Hence the technique of this operation for approaching the hip-joint will commend itself to modern surgeons. Nowadays surgeons, not being content with merely opening a joint, have something to do and carry out inside that joint, which work requires the guidance of our sense of sight and not of our comparatively coarse sense of touch. Giving instruction in operative surgery has demonstrated this to me, and the advantage of this trochanteric method of opening the hip-joint.

[1] As read before the Royal Society of Medicine, London.

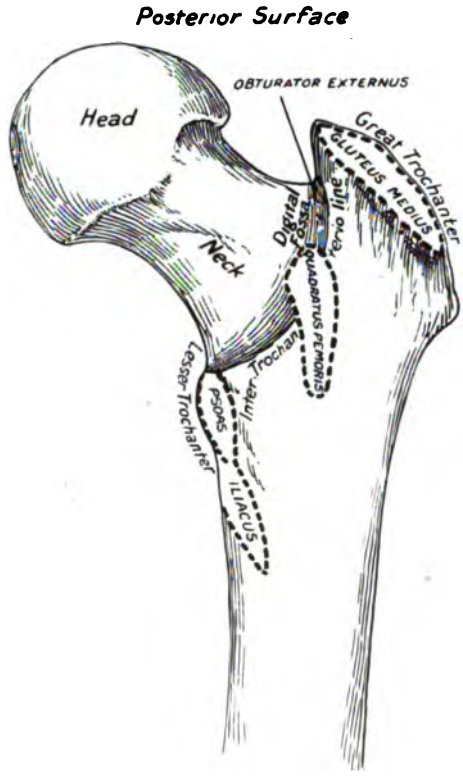



Fig. 3.

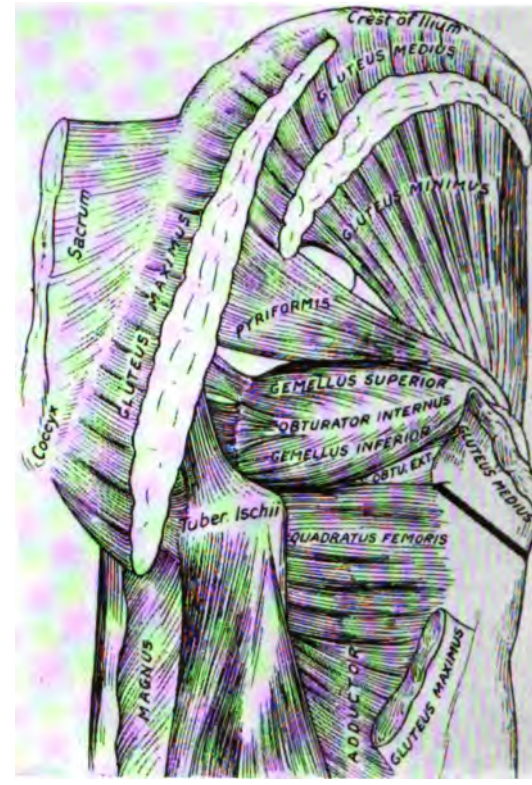



Fig. 4. The muscles behind the hip-joint. The black line shows the oblique direction of the saw cut. The great sciatic nerve emerging between the pyriformis muscle and the superior gemellus is retracted with the muscles attached to the tip of the trochanter.

I have used this method for a great variety of cases. Such operations have been for arthrectomy of the hip for the eradication of tuberculosis, the reposition of a congenital dislocation, for fractures of the neck of the femur, for separation of the upper epiphysis of the femur, for the making of a new hip-joint.

When operating on the hip through the anterior incision or any modification of it, especially when sawing through the neck of the femur, the thought has come to me: "What of the great sciatic nerve?" In the method suggested, when retracting the separated tip of the trochanter and the muscles attached to it, the latter retracts the great sciatic nerve as it passes between the pyriformis and superior gemellus muscles (Fig. 4). Thus it is drawn beyond the possibility of injury by two soft retractors — an ideal procedure.

The greatest bar to perfect success from an operation of arthroplasty for a dislocated or

ankylosed hip for some years' duration in a growing subject is a growth-deformity of the upper part of the femur. It is a torsion of the upper part of the femur produced by the growth of the neck of the bone against the side of the pelvis. This is a very serious barrier for the surgeon to surmount successfully. I have done this best by dividing the operation into two separate parts—first the arthroplasty, second a subtrochanteric osteotomy. But I am not sure that it may not be better to do the nearthrosis below the trochanter and leave the head of the femur above when the deformity has been present for some years during the period of active growth. In cases of upward dislocation of the femur the

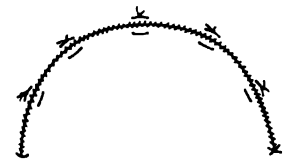


Fig. 5. The method of closure of the skin wound.

muscles attached to the tip of the great trochanter have become so shortened that it is impossible to replace the separated fragment when the dislocation has been reduced. But I have never seen harm follow from this, although the tip of the trochanter may be half an inch away from the femur.

---

# THE TREATMENT OF SCOLIOSIS

By A. MACKENZIE FORBES, M. D., Montreal, Canada
Lecturer in Orthopedic Surgery, McGill University

THE ideal treatment of any deformity is its rapid and complete reduction by *force majeure*. This is exemplified very nicely by the operative treatment of bow-legs and knock-knee. These, however, are amongst the simplest deformities. Can we treat the more complex in the same way? This seems doubtful. Perhaps the most complex of all deformities is that known as scoliosis. Here all the vertebræ, all the ribs, the pelvis, and the sternum may be involved. How different, then, is the problem here from the problem involved in the treatment of a bent femur or a bowed leg. Can our failures in the past be attributed to the fact that we have not appreciated the complexity of the deformity and the correlation of movements in the thorax? It has always been the custom to treat scoliosis as we would a bent stick, feeling, I fear, that we were dealing more particularly with a deformity of the spine. To remedy this so-called spinal deformity we adopted the principle of leverage. Force and resistance were our agents. Pull and counter-pull were the forms of treatment usually employed. These forces were exerted on the rib wall of the thorax because it was not possible to exert the same directly on the deformed spine. Now pull and counter-pull produced side-bending. Side-bending, although not the best means of reducing a lateral deviation of this column, is an efficient means if we use side-bending and side-bending alone, but this is not possible by any practical application of the principle of leverage; thus the majority of forms of treatment of scoliosis have, whilst tending to correct the lateral deviation of the spine, tended also to compress the already compressed ribs. Now, modern physiology tells us that there is a constant relationship between lateral deviation of the spine, rotation of the individual vertebræ, and compression of the ribs. It teaches that lateral compression causes rotation of the vertebræ toward the side on which the compression is exerted (1, 2, 3, 4). If this be so, that compression causes rotation toward the side compressed, those who have endeavored to correct in the way suggested have corrected in the theoretical ratio of two for correction and one for deformity.

To this point, our theories have been destructive. Can they be used as the basis of a constructive form of treatment? In other words, how is it possible to treat a patient suffering from organic scoliosis without exerting a deforming influence? The answer is, simply by the production of physiological scoliosis of a converse description to that of the pathological scoliosis already existing. This can be depended upon as the best form of correction. It, combined with the slow and gradual process of Wolff's law,[1] is the only means of rectification

[1] Wolff's Law.—Professor Julius Wolff, of Berlin, formulated the following law, which has since borne his name: "Every change in the form and function of the bones, or of their function alone, is followed by certain definite changes in their internal architecture and equally definite secondary alteration of their internal formation in accordance with mathematical laws."

Fig. 1. M. L. A child suffering from scoliosis with the convexity to the right. This patient has been rotated as far as possible to the left; i. e., away from the convexity of the curve. This treatment increases the deformity — the flattening of the ribs on the right side and the convexity of the curve to the right.

Fig. 2. M. L. The same child as in Fig. 1. The child has now been rotated as far as possible to the right; i. e., towards the convexity of the spinal curve. It is to be noticed that the deformity has been improved here. The spine seems straighter. The flattened ribs on the right side have been broadened.

at present available. Physiological scoliosis is produced by two means — by side-bending and by rotation. I believe that the latter is the best means, because rotation is the freest of all movements in the dorsal region; thus the greatest correction is available by it. I, therefore, advocate the rotation treatment for the physiological reduction of the deformity of scoliosis. The practical application of this form of treatment is best carried out by rotating the patient by means of the arms toward the side of the convexity of the organic (if dorsal) deformity. This may be done while the lower extremities are flexed on an already flexed spine. This attitude is best procured in the recumbent position. Correction having been produced in this manner (1, 2, 3, 4), it must be maintained by the use of a plaster of Paris or celluloid jacket.

If maintained for a sufficient length of time and under suitable conditions, the law of Wolff can be depended upon to assure that correction of a deformity for the correction of which we are without knowledge of forcible means.

BIBLIOGRAPHY

1. N. Y. M. J., 1912, July 6.
2. J. Canad. M. Ass., 1912.
3. Brit. M. J., 1913, Aug. 30.
4. J. Am. Orth. Ass., 1913, Feb.

# UTERINE ENDOSCOPY; AN AID TO PRECISION IN THE DIAGNOSIS OF INTRA-UTERINE DISEASE[1]

## A Preliminary Report, with the Presentation of a New Uteroscope

By ALFRED HEINEBERG, M. D., Philadelphia
Associate in Gynecology, Jefferson Medical College; Assistant Gynecologist to St. Agnes and Mt. Sinai Hospitals

THE diagnostic methods usually employed to determine the nature of intra-uterine disease frequently fail to afford the desired information.

A brief review of the methods in common use will serve to show how lacking in precision they are. First, bimanual, or vagino-abdominal palpation, applied under the most favorable circumstances, discloses only abnormalities in size, contour, position, and mobility of the uterus and other pelvic viscera. Even after such examination, the nature of any disease existing within the uterus can only be surmised from our knowledge of pelvic pathology and previous experience in such cases. Second, the use of the uterine probe in exploring the cavity of the uterus adds very little to the information obtained through the bimanual procedure. By sounding the uterine cavity, its depth and possibly any gross irregularity in its shape, also the presence of large tumors extending into it, may be determined; but disease of the endometrium, such as polypoid endometritis or malignant degeneration, would still evade detection. Third, digital exploration of the uterine cavity is a procedure which is attended by many difficulties. It is rarely resorted to, and even when used rarely affords satisfactory information. Few of us are provided with an index finger so small that it may be easily introduced through a cervical canal, even after its fullest dilation. Few, if any, of us have pursued this method of examination with sufficient zeal to enable us to differentiate with certainty the serious from the benign lesions of the endometrium.

The last diagnostic method usually resorted to, if one excludes the examination of the uterus after its complete removal, consists in curettage of the uterine mucous membrane and microscopic study of the scrapings. While yielding more precise information than any of the others, even this method proves disappointing and frequently leaves us in a state of uncertainty.

The necessity for greater precision in the diagnosis of intra-uterine disease, especially in cases of suspected malignant neoplasms of the fundus of the uterus, was most forcibly impressed upon me by two cases recently observed. One, a woman of 45, with suspected cancer of the body, was subjected to curettement. The pathologic report of the scrapings was negative for cancer. In three months the symptoms, chiefly hæmorhage, returned, and believing that cancer must be present, the uterus was removed. The patient died in three days from general peritonitis. The uterine mucous membrane had undergone polypoid degeneration, but showed no evidence of carcinoma.

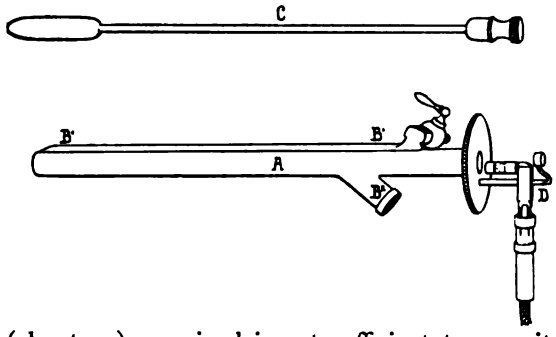
The second patient was subjected to a vaginal hysterectomy, on the supposition that she, too, had incipient cancer. Thorough examination of the uterus failed to reveal anything more than hyperplastic endometritis, which probably would have yielded to thorough curettage. The life of one patient and the uterus of the other were sacrificed to uncertainty in diagnosis.

In the attempt to reduce and if possible eliminate the perplexity in which similar cases have left us, I have devised an instrument — the uteroscope or uterine endoscope — which enables us to explore the cavity of the uterus and carefully inspect the entire endometrium. It is not recommended as a panacea for all of our diagnostic ailments, but as an aid in determining the cause of some uterine diseases of obscure origin. Its use in just the type of case detailed above should be of incalculable benefit to both patient and surgeon. Through its employment it should be possible to distinguish, with a greater degree of certainty, such pathologic conditions as glandular hyperplasia, uterine polyps, retained products of conception, submucous fibroids, and malignant tumors of the endometrium. The microscopic changes occurring in the mucosa during menstruation might also be observed in favorable cases.

The uteroscope herewith presented consists of the following parts: endoscopic tube (A); irrigating attachment ($B_1$, inlet; $B_2$, outlet); obturator (C); lighting attachment (D), as in Young's urethroscope.

In order that I might perfect the technique of its employment and become familiar with the appearance of the endometrium in its different variations from the normal, I have used it in every case subjected to dilation and curettement during the last six weeks. The number of uteri

[1] Read before the Philadelphia Obstetric Society, January 2, 1914.




(about 20) examined is not sufficient to permit me at this time to present a great amount of important data concerning the endometrium, either in its normal or pathologic states. The following observations, however, have been made:

The mucous lining of the body of the uterus is dark red in color and of a velvety appearance. It bleeds easily, when subjected to even slight trauma. After complete dilation (to 46 French) the internal os contracts again quickly, and on gradually withdrawing the uteroscope, can be distinctly observed as a narrow gateway between the cavities of the corpus uteri and the cervix.

The color of the mucous membrane of the cervix varies from yellowish to pinkish, according to the degree of congestion in the small blood-vessels, which latter can sometimes be distinguished. The arbor vitæ arrangement of the mucous membrane in cervices which are not badly lacerated is readily observed.

In one case of glandular hyperplasia — so-called villous endometritis — of the hæmorrhagic type, producing symptoms simulating cancer, the entire mucous membrane of the body presented a distinctly shaggy appearance, and when removed was found to be greatly thickened.

In a case of incomplete abortion, a piece of fœtal envelope, yellowish in color and about one-half inch long and one-third inch in diameter, was observed attached to the fundus near the uterine orifice of the left tube, and was easily and completely removed with small placental forceps.

*Technique.* The examinations with the uteroscope thus far made have been under general anæsthesia, but it is my purpose in suitable cases to resort to local anæsthesia of the cervix and uterine body by the injection of novocaine, alone or combined with adrenalin.

In the use of the uteroscope, as in other intra-uterine manipulations, asepsis of the vagina is essential and should be obtained by approved methods. The uteroscope is sterilized as follows: the metal tube and obturator are boiled for at least five minutes; the lamp holder and lens are immersed in 70 per cent alcohol for at least ten minutes; a sterile muslin bag is slipped over the electric cord and secured to the metal end by a purse-string. All parts can thus be handled without infecting the fingers of the operator.

Anæsthesia having been obtained, a self-retaining univalve speculum is introduced into the vagina to retract the perineum; the anterior lip of the cervix is grasped with two double tenacula, and the cervical canal dilated with graduated bougies. The dilation should be done very carefully in order to limit the hæmorrhage resulting from laceration of the tissues around the internal os. After thorough dilation (to 46 French) the uteroscope is introduced until the point of the obturator meets the resisting wall of the fundus, when the obturator is to be withdrawn. The desired degree of illumination having been previously obtained, the cord is attached to the lamp holder and this in turn to the endoscope.

It is well to flush the uterine cavity with saline solution at 110° F. by means of the irrigating attachment and to swab it gently through the tube before making the observations.

The chief difficulties encountered in the use of the uteroscope are hæmorrhage and acute flexions of the uterus. The latter is usually overcome by dilating the uterus with graduated bougies, if proper precautions are observed to prevent puncture of the uterine wall. Thorough dilation having been procured, the introduction of the uteroscope is attended with little or no difficulty.

Profuse and uncontrollable hæmorrhage prevents satisfactory examination with the uteroscope. The difficulty produced by a small amount of bleeding may be surmounted by flushing the uterine cavity through the irrigating attachment, with saline solution at 110°–115° F., and swabbing with cotton or gauze through the endoscopic tube by aid of long forceps. If this is not successful, the uterine cavity should be tightly packed for a few minutes with gauze, either plain or saturated with 1–4000 solution of adrenalin chloride.

*Contra-indications.* Uteroscopy, like other intra-uterine manipulations, has within itself the possibility of injury if unwisely employed. It seems almost unnecessary to caution against its use when pregnancy is known to exist or is even suspected. It is contra-indicated in acute infections and inflammations of the genital tract and periuterine structures. Its application during the existence of chronic pelvic inflammatory disease should be limited to those cases in which operative treatment of the diseased parts is to be immediately undertaken; for it must not be forgotten that

traumatism of the uterine tissues is likely to result in a relighting of a latent pelvic inflammation.

While not contra-indicated in those cases of pelvic disease in which the changes in the uterus itself are of less importance compared with concomitant disease of the other pelvic viscera, the information which it affords is of doubtful utility, from the standpoint of either diagnosis or treatment.

CONCLUSIONS

1. There is a well-recognized need for methods of greater precision in the diagnosis of intrauterine disease.

2. Greater accuracy in the diagnosis will diminish the resort to unnecessary and destructive operations.

3. Uteroscopy affords information concerning changes in the endometrium *in vivo*, not obtainable by any other method of investigation.

4. Uteroscopy, like similar diagnostic procedures, has its limitations and definite contra-indications.

Its use should be restricted to those cases in which it can elicit valuable information without endangering the health or life of the patient.

---

# LARYNGECTOMY COMBINED WITH GASTROSTOMY [1]

By FRANZ TOREK, A. M., M. D., New York City

Surgeon to the German Hospital and the New York Skin and Cancer Hospital; Adjunct Professor of Surgery in the New York Post-Graduate Medical School

THE feeding of a patient who has been subjected to an extensive laryngectomy, especially if complicated by a partial resection of the pharynx, is attended by difficulties and dangers. If a permanent tube is introduced through the nose into the œsophagus, its constant presence not only causes the patient much inconvenience but also interferes with the healing of the wound, through the fact that the tube, which cannot be kept aseptic, rests against the suture of the pharynx. This suture becomes infected and gives way, and not rarely necrosis results. The infection spreads downward, and the tracheal stump, which had been sutured to the skin, may separate from it here and there. It may then happen that, even after the patient has successfully rallied from the operation as such, he will aspirate secretions and succumb to a pneumonia.

If, on the other hand, the stomach tube is introduced every time the patient is to be fed, the conditions are, if anything, still worse, for the introduction of the tube, which will be done at least occasionally by the nurses, may easily result in perforation of the suture line. I have experienced such a case in which the tube had been pushed through the suture line of the pharynx, and the accident was not noticed until the fluid food that was poured into the tube ran through the dressings into the patient's lap.

In the case here presented I overcame these difficulties in a very simple way. When the larynygectomy had been completed, I performed a gastrostomy according to Witzel's method, in order to administer the food through the gastric fistula. The case was far advanced, one in which not only the whole larynx and epiglottis had to be removed, but the anterior wall of the pharynx also had to be resected to the extent of 3 or 4 cm., and a portion of the base of the tongue likewise had to be excised. Under these circumstances, the conditions for suturing the pharynx were, of course, very unfavorable. Nevertheless, although on the sixth day the presence of mucus in the wound gave proof that a portion of the wound had given way, the after-treatment, particularly as regards the change of dressings, was so simple that the difference between this case and former ones was marked.

The healing of the wound progressed without any disturbance. The pharynx fistula closed after four and one-half weeks, and the patient could again swallow both fluid and solid food. At the same time the gastrostomy tube was removed, and the gastric fistula closed promptly without leaking a drop.

The addition of a gastrostomy to an extirpation of the larynx does not add very materially to the severity of the operation, for the laryngectomy is done, as I have lately always performed it, under local anæsthesia. In such advanced cases the severe dyspnœa forbids operating under general anæsthesia, unless one has chosen to perform a preliminary tracheotomy. This, however, one will prefer to avoid in the interest of asepsis. For local anæsthesia I employ a one-half per cent solution of novocaine with suprarenin, deep injections being made to anæsthetize

[1] Patient and specimen were presented at a meeting of the Surgical Section of the New York Academy of Medicine, December 5, 1913, and before the Laryngological Section on December 17, 1913.

additional advantage of protecting the skin from X-ray injuries. Skin injuries could not always be avoided by the use of an aluminum filter up to 2 mm. thickness and a focal distance of 20 cm. However, if a 3 mm. filter is used under the same conditions, and an erythem dose is then applied, injuries to the skin were not observed in many thousand applications. The dose of the filtered rays may be increased intentionally or unintentionally, even up to 4 erythem doses without injuries to the skin becoming apparent. Of course, we must consider that 10 X of filtered rays represent an entirely different amount of energy than 10 X of unfiltered rays. But 10 X filtered rays exceed the same amount of unfiltered rays in deep penetrating action and biologic effect although the erythem dose of the filtered is higher.

The unit of X-ray measure is the erythem dose, which, when applied to the skin, causes slight inflammatory irritation and loss of hair. As the period of latency of the X-ray action amounts to fourteen days, it is apparent that the normal amount per month is the application of two erythem doses of unfiltered rays to the given region.

X-rays produce a change in color of barium platinum cyanide. The latter is applied to a disc which is placed at the half focal distance and exposed to the action of the rays. It is then gradually discolored brown. The skin has received an erythem dose when the discoloration of the disc corresponds to a test color. Holzknecht has devised a color scale. Five H corresponds to one erythem dose or 10 X.

Another protection of the skin is, finally, the application of the rays through a number of fields (15). An amount of rays injurious to the skin is equally divided, the divided dosage is sent into the body through several fields or portals of entry, and the tube is tilted so that the rays will strike the same place in the interior of the body.

It is certainly a waste of time to mention all the different methods of massive ray treatment. In describing the method, the focal distance, the amperage of the secondary current, the hardness of the tube, the duration of the treatment, the filter used and the number of fields must be given. If any of these six points is omitted, the record of the remaining points is valueless.

Two extremes in the methods of deep raying exist. The one, introduced by Albers-Schönberg, advocates a moderation in treatment; the other, fathered by Gauss, insists on a radical, intensive method —"mehrstellige Filternahbestrahlung." It is characterized by a filtering of the rays through an aluminum sheet of 3 mm. thickness, a focal distance of not more than 20 cm., and a crossfire action through the greatest number of portals or fields possible.

Albers-Schönberg uses a tube of 6–8 Walter, the secondary current is 3 to 4 m. amp., the focal distance is 38 cm., and the filter consists of four layers of goatskin leather, each of 1 mm. thickness. The intestines are displaced by a compression tube. The latter also compresses the skin. The methods for massive raying are two, a slow and an accelerated tempo (16). The former consists of a séance of six minutes on three successive days, which constitutes a series, an intermission of fourteen days, then another series, etc. The latter method employs a series through the anterior abdominal wall, eight days intermission, then another through the back, eight days intermission, another through the anterior abdominal wall, etc. An X-ray dosage of 7½ X is not exceeded during any one sitting. Therefore, two erythem doses are never given to any one region of the skin during a month. The treatment is immediately stopped as soon as a skin reaction appears or the purpose of the treatment, i.e., oligo- or amenorrhœa, has been attained, so that no more rays are used than are absolutely necessary.

The Freiburger or Gauss (17) method is executed as follows: The focal distance is 20 cm., the milliamperage of current 5 to 12, the filter aluminum, 3 mm. thick, the hardness of the tube 9.5 to 10 Wehnelt, the number of fields 40 to 60, the amount of rays in a series of six séances 300 to 600 X, the average amount of dosage of the treatment being 1475 X.

My method attempts to keep within the middle of these two extremes. I use a focal distance of 20 to 22 cm., a tube of 9 to 10 Wehnelt, a current of 4 to 5 ma., an aluminum filter of 3 mm. thickness. The number of fields amounts to 6 to 12 depending on the size of the abdomen and that of the pelvic organs. Each field measures 5 sq. cm. and is exposed twice during a series of six daily sittings. The amount of dosage per field varies from 8 X to 10 X. The total amount given during one series, from 120 to 240 X. An intermission of three weeks is taken between series. The skin is compressed by a tube and the intestines are displaced, as much as possible, by a slight elevation of the pelvis.

Gauss claims the following advantages for his method: 100 per cent cures, shortening of the time of treatment to an average of five weeks. Malignant changes in the uterus or ovaries can be early recognized on account of the short

duration of the treatment and therefore subjected to a timely operation. This invalidates any apparent opposition towards gynecologic röntgen treatment on account of a supposed delay or procrastination. Missed diagnoses, also, are rendered less objectionable on account of the shortening of the time of treatment.

The accessory action of the X-rays are formation of connective tissue, Eiselsberg (18), Henkel (19), Abel (20), Bumm (21); röntgen peritonitis with acute œdema, reddening, exudation, Klein (22); diarrhœa, injuries to intestinal mucous membrane, Haendly (23), Hengge (24), Wetterer, Bumm (25); röntgen intoxication, Krinski (26); latent ulcer, one year after treatment, Quervain (27); röntgen paralyses and absorption fever (Foveau de Courmelles (28), Haendly (29)). Röntgenologists who are or have been exposed to a summation of large amounts of rays often show changes in the blood, probably caused by an involvement of the bone-marrow and the entire lymphatic system, Köhler (30). These observations and deliberations must convince one that we do not as yet perfectly comprehend the biologic, temporal and local extent of the action of the X-rays. We are compelled to employ only the smallest possible amount of rays (31).

The most favorable time for the application of the rays in relation to the occurrence of menstruation is as soon as possible after the cessation of the period, especially if moderate doses of rays are to be used. Moderate dosage causes an irritation of the ovaries, which, in turn, brings about an increase in the amount of the flow at the next menstrual period. Massive rays, however, inhibit the function of the ovaries which is asserted by a decrease or complete cessation of the menstrual flow.

Finally, we will consider the therapeutic indications. Those diseases are available for röntgen treatment which are caused by an abnormal function of the ovaries. Kierstein holds that if a diseased condition is benefited by a raying of the genital organs so that the chief symptoms disappear, it originally must have been due to a disturbance of the ovarian function. As the ovaries almost exclusively cause uterine hæmorrhages, the latter furnish the chief cases for the gynecologic X-ray treatment. It is clear that the nearer the patient approaches the natural climacterium or change of life, the easier, the surer and the quicker may she be relieved of her hæmorrhages. The climacteric, pre- and post-climacteric hæmorrhages, the so-called hæmorrhagic metropathies, belong to this category. The röntgen treatment of these hæmorrhages must be preceded by a curettage. X-ray therapy is not a diagnostic but only a therapeutic agent. X-raying of chronic metritides with hæmorrhages does not differ from that of the essential or idiopathic hæmorrhages.

The indications and contraindications for the treatment of myoma by means of the X-ray differ according to the authors. Krönig and Gauss (32) very decidedly advocate the treatment of myoma by their intensive, massive method. "The surgical treatment has ceased to be the procedure of choice in the treatment of myomata and hæmorrhagic metropathies. The operative treatment is at present reserved for a few exceptional cases only, in which, for various reasons, radiotherapy is apparently not suited." The radiotherapy is contra-indicated in the following instances according to Krönig (33):

1. Pedunculated submucous myomata already partly expelled through the cervix. 2. When gangrene is suspected in the myomata. 3. If the myomata are complicated by cancer of the mucous membrane. 4. Myomata in which we must suspect a sarcomatous degeneration on account of rapid growth, severe metrorrhagias and unsuccessful röntgenotherapy. 5. Myomata which are causing an acute incarceration of the bladder.

The raying of the myomata must also be refused before the 35th to 40th year of life. While myomata with severe anæmias, causing subsequent weakness of the heart and a hæmoglobin percentage of 10 to 20% must be rayed by all means (Krönig, Gauss, Menge and Fränkel).

The indications, according to Menge, are as follows: 1. Myomata of older patients which cause symptoms without causing disturbances of health. 2. Myomata with rapid growth and general disturbances (anæmia, disturbances of the circulatory and urinary organs) occurring in women older than 40 years.

Pruritus vulvæ, dysmenorrhœa and inflammatory adnexal diseases have been successfully rayed. However, the opposite holds good for inoperable malignant pelvic tumors. I have never seen a betterment of the subjective, much less of the objective symptoms after the most careful and painstaking treatments. This fact, however, is not to be regarded as an unfortunate one, as we possess therapeutic agents in radium and mesothorium, which, in all probability, will enable us to successfully fight this dreaded enemy of the unfortunate bearers.

In conclusion, I repeat the warning of Menge,

made to his brother gynecologists, that they had better perfect themselves in the technique of this new treatment, for, if they do not do so of their own accord, they will be compelled to do so by the demand of the general practitioners and the laity; if they resist, then the greater number of myoma patients will pass out of their hands into those of the skiagraphers, which would be a most unfortunate result, because of the difficulty in determining just which cases are suitable for X-ray treatment, and which should be subjected to operation, a diagnosis that can be made by a trained gynecologist only.

## REFERENCES


1. Gauss. Weitere Fortschr. a. d. Geb. d. gynäkologischen Röntgentherapie. Strahlentherapie, 1912. Nos. 1 and 2, p. 132.
2. Halberstätter. Die Einwirkung der Röntgenstrahlen auf Ovarien. Berl. Klin. Wchnschr., 1905, No. 3, p. 64.
3. Specht. Mikroskopische Befunde an röntgenisierten Kaninchenovarien. Arch. f. Gynäk. 1906, lxxviii, p. 64.
4. Zaretzky. Die Röntgenbestrahlung der Eierstöcke. Inaug. Dissert. Petersburg, 1908, Publ. Suworin. Russian.
5. Rosen, Véra. Contribution à l'étude de l'influence des rayons x sur les ovaires de la femme. Thèse, Lausanne, 1907.
6. Reifferscheid. Experimentelle Untersuchungen über die Wirkung der Röntgenstrahlen auf die Ovarien. Monatschr. f. Geburtsh. u. Gynäk., 1911, xxxiii, p. 144.
7. Faber. Einwirkung von Röntgenstrahlen auf die Sexualorgane von Tier und Mensch. Fortschr. a. d. Geb. d. Röntgenstr., xvi, p. 435.
8. Runge. Monatschr. f. Geburtsh. u. Gynäk., 1912, xxxvi.
9. Eymer. Die Röntgenstrahlen in Gynäkologie und Geburtshilfe. Fortschr. a. d. Geb. d. Röntgenstrahl., 1913, Erg. xxix, p. 11.
10. Gauss and Lembke. Röntgentiefentherapie, 1912, p. 121.
11. Christen. Der absolute Härtemesser, Strahlentherapie, 1912, i, pp. 51 and 325.
12. Hoehne and Linzenmeyer. Untersuchung über die Lage der Ovarien an der Lebenden mit Rücksicht auf Röntgenbehandlung. Strahlentherapie, i, p. 141.
13. Mayer. Die Grundlagen der Röntgentiefentherapie in der Gynäkologie. Strahlentherapie, i, p. 394.
14. Gauss and Lembke. Röntgentiefentherapie, p. 147, ff.
15. Same, p. 193.
16. Same, p. 193.
17. Same, p. 215.
18. Eiselsberg. Citiert bei Fränkel, Röntgenbehandlung in der Gynäkologie, Berl. Klin. Wchnschr., 1912, p. 1610.
19. Henkel. Verhandl. d. Gesellsch. f. Geburtsh. u. Gynäk., 1912, p. 468.
20. Abel. VI Internat. Kongress f. Geburtsh. u. Gynäk., Berlin, Zentralbl. f. Gynäk., 1912, p. 1322.
21. Bumm. Ztschr. f. Geburtsh. u. Gynäk., lxxii, 800.
22. Klein. Myome und Röntgenstrahlen. Monatschr. f. Geburtsh. u. Gynäk., 1912, xxxvi, p. 589.
23. Haendly, P. Anwendung der Röntgenstrahlen in der Gynäkologie., Ref. Ztschr. f. Geburtsh. u. Gynäk., 1912, No. 72, p. 197.
24. Hengge. Monatschr. f. Geburtsh. u. Gynäk., xxxv, p. 650.
25. Bumm. Diskussion zur Röntgenbehandlung in der Gynäkologie. Gesellsch. f. Geburtsh. u. Gynäk., 1912, May 10, Ztschr. f. Geburtsh. u. Gynäk., 1912, lxxii, p. 499.
26. Krinski. Strahlentherapie, 1912, i, No. 4, p. 477.
27. Quervain. Cited by Iselin H., Schädigungen der Haut durch Röntgenlicht nach Tiefenbestrahlung. Kummulierende Wirkung. München. med. Wchnschr., 1912, No. 49 u. 50.
28. Foveau de Courmelles. Le radiothérapie des fibromes. Revue de thérapeutique médico-chirurgicale, June, 1906.
29. Haendly. Ztschr. f. Geburtsh. u. Gynäk., 1912, lxxii, p. 758.
30. Köhler. Zur Verantwortlichkeit des Vorgesetzten für den Schutz seines Röntgenpersonals. Deutsche med. Wchnschr., 1912, p. 2036.
31. Kierstein. Die Röntgentherapie in der Gynäkologie. Berlin, Publ. Springer, 1913, p. 49 u. ff.
32. Krönig und Gauss. Zur Röntgenbehandlung d. Myome. Deutsche med. Wchnschr., 1912, p. 940.
33. Döderlein-Krönig. Operative Gynäkologie, III Edition, 1912, p. 429.
34. Menge. Specielle Indikationsstellung der Röntgentherapie bei Myomatosis uteri. Monatschr. f. Geburtsh. u. Gynäk., 1912, xxxv, p. 268.

# A DOUBLE LEVER INSTRUMENT DEVISED FOR THE OPEN REDUCTION OF FRACTURES

By FREDERIC HUNTINGTON COERR, M. D., New York City
Assistant Surgeon, Fordham Hospital

TO accomplish the successful reduction of certain transverse fractures, especially supracondyloid fractures, often necessitates great trauma to the fragments and to the soft tissues. The operation is sometimes abandoned without a satisfactory replacement of the fragments.

The instrument herein described is devised to prevent unnecessary trauma and to permit an easy reduction.

It consists of three pieces, i.e., a lower stationary bar, an upper adjustable bar and a set-screw.

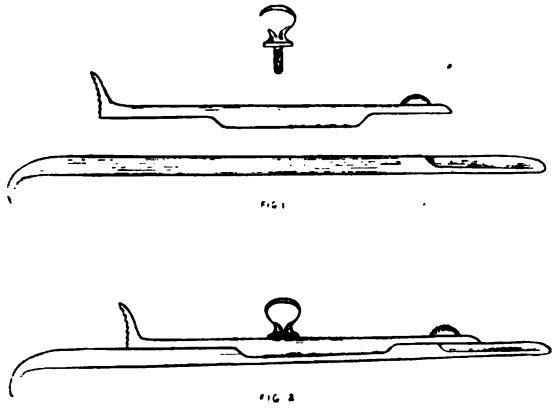


Fig. 1. The component parts of the instrument.
Fig. 2. Appearance when assembled.

The curved end of the lower bar, serrated with the sharp edges slanting upward, is inserted between the upper and lower fragments, engaging the fractured end of the lower fragment. The spur of the upper bar, serrated, with the sharp edges slanting downward, is then adjusted against the fractured end of the upper fragment and maintained in this position by tightening the set-screw.

The handle being raised by slow, steady pressure, a double lever action ensues, each fractured end acting as a fulcrum to the other. The lower fragment is forced distally, and the upper fragment, proximally. The action continuing, the lower fragment is elevated and the upper fragment depressed until they are in direct alignment. Further action could cause complete reversal of the former relationship of the fragments.

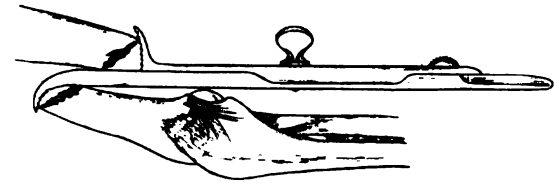


Fig. 3. The instrument in position preparatory to the leverage action caused by raising the handle. The curved end of the lower bar has engaged the fractured end of the lower fragment, the spur of the upper bar has been adjusted against the fractured end of the upper fragment and the set-screw tightened, maintaining it in this position.

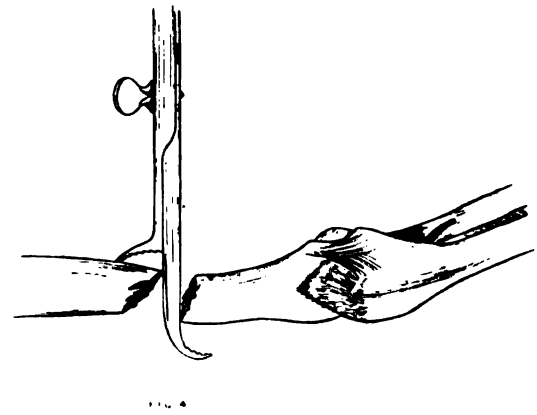


Fig. 4. The instrument in vertical position, having pushed the lower and upper fragments respectively distally and proximally. The lower fragment should be represented as nestling in the curved end as its apparent position is obtained only by further downward pressure of the handle.

When the fragments are in the desired position, the instrument may be removed by a reverse action, or, in fracture of the long bones, may remain *in situ*, holding the fractured ends while a Lowman clamp is applied.

I am indebted to Dr. Alfred Braun for the illustrations.

# HEAD INJURIES. SOME CONCLUSIONS

By W. J. ANDERSON, M. D., Chicago
Late Assistant Warden, Cook County Hospital

DURING the year of 1912 there were 298 cases of head injuries admitted to the Cook County Hospital. These do not include the ordinary scalp wounds, numbering over 1000 cases, which are known as "dress cases" or "dispensary cases."

Of these 298 cases admitted, 130 were diagnosed as skull fractures, 120 as scalp wounds, 22 as gunshots, 15 as cerebral concussion, and 11 as infected scalp wounds.

Of the 130 cases of skull fractures, 72 were recognized as involving the vault and 58 were termed basal fractures. This classification was made by the examining room interne, and a revision due to more perfect and deliberate examining in the wards showed that in the main the initial diagnosis was correct. Of course it is to be understood that in a large number of the fatal cases the injury was so severe as to involve the base as well as the vault.

The diagnosis of fractures of the vault was made by direct inspection, cutting down through the pericranium whenever necessary. Twenty-six of 72 recovered, making the mortality 64 per cent. Whenever a depression existed or where there was a linear fracture in the neighborhood of a meningeal vessel with focal symptoms or coma, a decompression operation was done. To tabulate:

SKULL FRACTURES OF THE VAULT

| Admitted | | Recovered | Died |
|---|---|---|---|
| Males | 59 | 21 | 38 |
| Females | 4 | .. | 4 |
| Children | | | |
| Males | 8 | 5 | 3 |
| Females | 1 | .. | 1 |
| | 72 | 26 | 46 |

Of the 58 cases of basal skull fractures, 25 recovered, making the mortality 56.9 per cent. The diagnosis of each case was made by the presence of blood in one of the cavities of the head, as the nose, throat, or ears, and was confirmed in most instances by spinal puncture, the latter measure being a routine diagnostic procedure in every suspicious cerebral case. Instances have occurred where there was a negative finding as far as the presence of blood in the spinal fluid was concerned, yet there was blood present within the auditory canal, the nasal cavity, or the pharynx. The treatment was expectant in each case excepting where a depressed fracture involving the vault coexisted with a basilar fracture. To tabulate:

BASAL SKULL FRACTURES

| Admitted | | Recovered | Died |
|---|---|---|---|
| Males | 51 | 22 | 29 |
| Females | 5 | 1 | 4 |
| Children | | | |
| Males | .. | .. | .. |
| Females | 2 | 2 | .. |
| | 58 | 25 | 33 |

Fifteen cases were diagnosed as cerebral concussion, and all recovered. With these cases there were cerebral symptoms present with a history of injury. While no distinct focal symptoms were present pointing to any particular cerebral location, yet they were admitted as a safeguard for further observation.

Of the 120 cases of scalp wounds admitted as hospital cases 105 were males and 15 females. Most of these cases were partly under the influence of alcohol, and a question of policy as to whether some of the symptoms might not be due to direct cerebral injury warranted us in admitting them as cases. That this policy was worth the extra expense to the hospital is shown in that 10 males developed active delirium tremens, 3 of whom died.

To tabulate the gunshots of the head:

GUNSHOTS OF THE HEAD

| Admitted | | Recovered | Died |
|---|---|---|---|
| Males | 17 | 6 | 11 |
| Females | 4 | 4 | .. |
| Children | | | |
| Males | 1 | .. | 1 |
| Females | .. | .. | .. |
| | 22 | 10 | 12 |

Eight of these cases were non-penetrating. All lived and none developed tetanus, leaving 14 cases in which the bullet or bullets entered the calvarium; 12 of these died, making the mortality 86 per cent. One of these cases died of tetanus.

Eleven cases of infected scalp wounds were admitted. These in every instance had received their inital treatment by some physician not connected with the institution.

The infection was of such a degree that ordinary dispensary treatment could not be recommended.

In one of the cases two scissors blades at least 2½ inches long were found embedded in the scalp. This man developed tetanus, but fortunately recovered.

Death in head injuries is either due to (1) surgical shock, (2) meningo-encephalitis, or (3) bronchopneumonia.

Now what conclusions or points of value can one gather from collecting or observing these cases? It is not my purpose to discuss exhaustively the subject of the diagnosis and the surgical technique one may apply to head injuries. It is merely my intent to call your attention to some of the important points which have been of value to us in the treatment of head injuries as they were admitted to this institution.

The greater number of scalp wound cases will be found under the influence of alcohol, and it is an exceedingly difficult problem to differentiate the symptoms due to alcoholism and cerebral symptoms due to injury of the cranial vault and its contents. We are frequently confronted with a case partly in stupor or in a coma with no previous history. The police bring him to the hospital. With no previous history the problem from a diagnostic standpoint becomes a very difficult one.

The most careful scrutiny for an abrasion of the scalp must be indulged in and a most rigid examination resorted to. One should recall the pathological and chemical conditions which may produce coma. The surroundings of the patient should be noticed; is there blood or vomitus near him? The depth of the coma should be ascertained; if possible, the man should be aroused by supra-orbital pressure or by brisk rubbing of the ribs in the axillary line with the knuckles of one hand, and asked to give an account of himself. His tongue should be examined for bites or scars. The breath should be noticed. The amount of muscular power and the state of his reflexes should then be observed, any inequality probably indicating a unilateral lesion within the cranial vault. The urine may be drawn off and examined for sugar or albumin. If there is any suspicion of poisoning the stomach should be washed out. Spinal puncture is of the utmost value, and in any case of doubt should always be resorted to. I am inclined to believe with Rothstein that it is never a dangerous procedure except in two conditions, viz: brain tumors, particularly those of the cerebellum, and in acute hydrocephalus with tuberculous involvement of the aqueduct of Sylvius. Ordinary precautions, however, should be used. It is not necessary to remove more than 15 to 20 ccm. of fluid for diagnostic or therapeutic purposes. The drop method should be used. For diagnostic purposes, if the fluid is not under tension, 2 to 5 ccm. is sufficient. The consistency of the fluid should be noted; is it clear, turbid, bloody, or does it contain flakes. Nearly all cases of cerebral injury have increased blood pressure. The slow pulse is characteristic in the early stages. It has been stated that the blood pressure apparatus may furnish an excellent guide as to the progress of a case with compression symptoms, and when used at the time of spinal puncture might indicate that sufficient fluid has been withdrawn. Those who have used this method state that a drop of ten degrees is a warning that enough fluid has been withdrawn. I have followed out these suggestions and have found them of no value.

The X-ray as a diagnostic measure is of value only in the hands of an experienced operator, one who has analyzed thousands of plates. No one should attempt to interpret a plate who has not studied the relationship between head injuries and the normal plate, since there is nothing so deceptive as an X-ray plate. In the majority of cases at least four views of the cranium should be taken. As the part nearest the plate shows the clearest, a front-to-back, a back-to-front, a right-to-left, and a left-to-right exposure should be taken. At times it is necessary to take from six to ten exposures to bring out a lesion of the cranial vault. A depression is rarely shown. Where bullets have entered the skull and the surgeon thinks it advisable to remove them, which question he should weigh with considerable thought after consultation with a competent neurologist, the X-ray plate should not be over an hour old and the operator should have measured the plates with the "localizer" to determine the precise position. The importance of this was shown to me in the late Bernstein murder case. This man received two bullet wounds: one entered the back in the lower left scapular region, had an oblique upward path about 30° and had its exit in the left neck above the clavicle; the other bullet entered the left occipital region and produced a right hemiplegia. The X-ray showed it lying under the vault in the left motor region close to the median line.

The man died shortly after, 48 hours from the time of his injury. On the post-mortem table the bullet was found at the wound of entrance in the occiput. He was posted within 12 hours after death, and it is a question whether the bullet gravitated through its path during life or after death. Such conditions of gravitation of bullets, according to LeCount, is by no means uncommon.

The probing of recent wounds for diagnostic purposes is recognized as a dangerous process. We believe with Lejar "that it is a dangerous and an illusory practice." Frequently I have watched junior internes probing a scalp wound for the possibility of fracture. They would feel fairly certain that a fracture existed. Advising them to cut down through the pericranium, retract the same, the skull would be found in the great majority of cases smooth and regular. The pericranium should be incised and the skull examined by direct inspection in every case in which there is the remotest suspicion of cerebral injury. That is where a scalp wound or a hæmatoma is present. I recall the case of a charity worker who had been hit by some vehicle. She was brought to the hospital by the police, in coma. No history of consciousness between the time of the accident and the appearance of the coma was obtainable. It could not be determined whether any paralysis existed except that one pupil was dilated. On the side of the dilated pupil in the parietal region was a large hæmatoma. Cutting around the hæmatoma as for a horseshoe flap, and reflecting the pericranium, a linear fracture was found. Proceeding with a decompression operation an extradural clot which extended, it seemed, over the entire right hemisphere was found. It appeared to be over one-fourth of an inch in thickness. Removing the greater part of the clot the source of the hæmorrhage was found to be the anterior branch of the middle meningeal artery. Fortunately it was an easy matter to ligate by passing a needle with catgut under the dura mater. Gauze drainage was used and the scalp sutured with its pericranium. Upon the completion of the operation both pupils were equal. No anæsthetic was necessary. The woman made a complete recovery, returning to consciousness after 48 hours, and to-day, after a lapse of six months, enjoys good mental and physical health. I have had two other cases similar as to the physical findings in that a hæmatoma existed on the same side as the dilated pupil. Yet one should not place too much reliance upon these findings, for corneal symptoms without other focal findings are not to be relied upon.

The question as to how to treat the dura mater in the acute traumatic cases is a good field for discussion. Should one for exploratory work make the crucial, the elliptical, or use any incision long enough to require suturing? Personally, I believe, no incision large enough to require suturing should be made for exploratory work. Should one upon exposing the dura find that the spaces underneath it show increased tension or that there is an absence of pulsation, then small linear punctures with the point of the scalpel should be made. Should these punctures show the presence of blood, then one may continue this incision and proceed to explore the cortex, giving the patient the full benefit of a decompression operation by removing a section of dura mater. To liken the subdural space to the peritoneal cavity, and that it may be drained in like manner, I believe is a fallacy. Likewise to tap the lateral ventricle in an acute traumatic cerebral condition, so that one may relieve hypertension, I believe accomplishes nothing. I have seen one such case treated; a small rubber tube was inserted into one of the ventricles—at least the operator thought he had the tube in the ventricle. The post-mortem showed that the tube had not been within one-fourth of an inch of the cavity. It is said that brain hernia does not occur without infection. I cannot recall a traumatic cerebral case where a decompression operation was done that did not show symptoms of infection. Then why should we make it a routine practice to make large incisions of the dura mater?

In conclusion, our mortality on the expectant plan for basal skull fracture during the year 1912 is shown to be 56.9 per cent. Should one continue by examining the histories of 1,000 cases of basal skull fracture, I believe the percentage would be much better. This brings the question forward as to when a basilar fracture should be operated upon.

It is my belief that the expectant plan is the best, and that the only indication for a decompression with a positive diagnosis of a straight basal fracture is, that after the patient has been under observation, with the coma and temperature the same, the pulse is found to advance from 40, 60 or 80 to 120 or more. Spinal puncture, when used intelligently, accomplishes about as much as a decompression operation in basilar fractures.

# BOOK REVIEWS

## A CRITIQUE OF NEW BOOKS IN SURGERY

By M. G. SEELIG, M. D., Saint Louis, Missouri

NOT since Osler's work on abdominal tumors has anything appeared approximating in significance this large monograph by Professor Schmidt;[1] and nothing mirrors more accurately the deplorable overshadowing of intrinsic surgical thought by surgical technique — the science by the art of surgery — than the fact that such productions as this one are so commonly furnished by internists, and so rarely by surgeons. Even he who has not enjoyed the privilege of working with Schmidt readily may appreciate the comment of the translator, Dr. Joseph Burke, regarding the "almost uncanny diagnostic ability" of the author.

The monograph is arranged in three parts, devoted respectively to (1) General Considerations, such as the technique of physical examination, clinical microscopy, and general symptomatology; (2) Neoplasms of Special Abdominal Organs, and (3) Case Histories. A careful reading of the first few pages of Part I suffices to make plain that, after all, Schmidt's diagnostic skill possesses nothing of the element of the uncanny, but rather rests upon the very solid basis of a highly refined power of detailed observation, combined with admirable capacity for inductive reasoning and incomparably well-developed associative processes of thought. This striking combination is emphasized all the more strongly by Schmidt's tendency, throughout the monograph, to place sole dependence upon the concrete facts and phenomena of pure medicine to the exclusion of the cognate sciences. In this he resembles the English school of clinicians as contrasted with such men as Krehl, Kraus, and von Norden on the continent.

A detailed study of cachexia, of the significance and sites of occurrence of seemingly slight œdemas, of abnormalities in skin and hair coloring, of the varying types of emaciation and of subtle alterations in temperament, furnishes the reader a mass of fundamental knowledge without raising even a suspicion of academic refinement.

Likewise, in the second part of the monograph, devoted to the special consideration of neoplasms of the stomach, liver, gall-bladder, pancreas and kidney, there is a wealth of observation and of minutiæ that must be startling to the average clinical mind, and that would be confusing were it not for the orderly manner in which the facts are developed under the several heads, as follows: Early symptoms, accompanying symptoms, facts elicited by physical examination of the stomach, accompanying symptoms from other organs, clinical microscopical findings, types of disease, with course and duration, and finally suspicious factors and differential diagnosis. It is a matter of no small interest that such a fund of data can be presented in such form as not even to graze the edge of the encyclopædic. A concrete example may possibly serve to show how Schmidt uses his facts, not for the purpose of classification, but rather for the elucidation of phenomena. Thus, under the head of "general considerations," he shows that the majority of patients who suffer from cancer of the stomach are descended from long-lived parents, and have themselves a clean past history— one, indeed, of "excessive well-being." Later, under the special head of cancer of the stomach, he notes the extreme rarity with which valvular lesions of the heart accompany gastric carcinoma; and he ventures an explanation on the basis of the excellent previous health of these patients who so rarely suffer from those infectious diseases that predispose to endocarditis. Again, the repeated find of atrophic spleens in gastric carcinoma patients who come to autopsy, moves Schmidt not to classify the fact as one of pathological significance, but rather as a not inconsiderable aid in differentiating carcinoma of the stomach from the often confusingly similar pernicious anæmia, in which the spleen is usually large.

The third part of the monograph, devoted to case histories, presents in condensed and yet adequate form one hundred and seventy-five case reports, each one of which illustrates some point brought out in the preceding text. One notes with surprise the statement, "I have never observed metastases in the inguinal glands" (with carcinoma of the stomach). Evidently, in spite of close observation of the richest possible material, Schmidt has not seen secondary involvement of the umbilicus with consequent inguinal metastases — a symptom-complex which, although it may not be common, does occur, and furnishes clinching evidence of visceral and particularly of gastric carcinosis.

Of course, one may diagnosticate, treat, and even cure some abdominal tumors, without commanding the mass of facts presented by Schmidt, just as one may be a clever musician without a knowledge

[1] Diagnosis of the Malignant Tumors of the Abdominal Viscera. By Professor Rudolph Schmidt. Authorized English Version by Joseph Burke, Sc. D., M. D. New York City: Rebman Company.

of the intricacies of harmony and counterpoint, and yet it would be difficult to single out one fact in the book as unessential.

THIS, the December number of the Murphy Clinics,[1] calls for special comment from several different points of view. In the first place—and praise be therefor!—the editing of this volume is incomparably better than has been the editing of the volumes issued in the past. In the second place, there is recorded a particularly admirable variety of case histories dealing with surgery of the gall-bladder, lung, osseous system, kidney, spinal cord, joints, and hernia. Thirdly, there is a clear and lucid exposition of the treatment of pulmonary tuberculosis by the production of artificial pneumothorax as practiced by Murphy and as first recommended by him in 1898.

The wisdom of the policy of republishing in the Clinics a paper written by Murphy sixteen years ago may properly be questioned, and yet one readily understands the promptings leading to such an addition to the Clinics. Regarding the appended list of cases operated upon by Murphy before the Clinical Congress of Surgeons, it is more difficult to form a judgment. He who believes that such a list, with notations as to the geographical distribution of the patients, offends a canon of good taste, must certainly be more or less justified in his belief. A comparison with the noise of bells and cymbals is not far from hand. And yet such details are essentially trivial, if one concentrates on the inherently, and we may even say uniquely, close surgical reasoning, clever clinical differentiation, and masterful command of clinical facts that fairly crowd the volume.

THE numerous excellent papers on the vascular system written by Bernheim during the past few years are gathered and elaborated in this small monograph,[2] which, in ten chapters, details the general technique of blood-vessel surgery, transfusion, end-to-end suture, lateral anastomosis, transplantation of segments of veins and arteries, arterio-venous anastomosis, varicose veins, surgery of the heart, and aneurisms.

So many of the worthy medical contributions of to-day may be found in monograph form that we have learned to welcome this type of medical thesis as an expression of personal opinion, experience, and critique. It is to be regretted, therefore, that Bernheim does not confine himself to that part of blood-vessel surgery which has engaged his own personal activities. The inadequately short and inconsequential chapters on varicose veins, and suture of the heart, and the rather bibliographic chapters on aneurism serve only to detract from the excellency of the preceding six chapters.

The reviewer can testify from personal experience to the absolutely essential importance of all the minute details of technique insisted upon by the author, but he has never yet been able to bring himself to the use of the Bernheim tubes or of any other intermediate apparatus, in the performance of transfusion. Anyone who has done much work in recording blood pressure in animals knows that even with the smoothest, cleanest, and best paraffined carotid cannulæ, clotting unavoidably occurs. It would hardly seem wise, therefore, to discard the valuable intima-to-intima principle as a routine measure, unless urgent haste demanded an indirect transfusion by means of tubes, syringes, or glass containers of the Kimpton type.

Eminently sane and rational is Bernheim's counsel to make careful hæmolytic tests of donor's and recipient's blood only when proper facilities are at hand and when urgency is not a factor, but to forego these tests, with equanimity, when urgency is a factor and when physical examination of donor and recipient points to no potential serious consequences.

The monograph is excellently illustrated, and should serve as a handbook for those unskilled in the art of transfusion, and, in particular, as a manual for those who seek to perfect their technique in the laboratory, the only place where the technique can be adequately mastered.

MORE than four years have elapsed since the first volume of Deaver's and Ashhurst's Surgery of the Upper Abdomen[3] appeared, a delay which the authors state to be due to the fact that so great a mass of literature had to be gone through; a delay, however, which makes the second volume necessarily more up to date than is the first. This second volume is made up of nine chapters, which are divided so as to consider, in order, under separate heads, the various diseases, tumors, and injuries of the gall-bladder and biliary ducts, liver, pancreas, and spleen, with a final chapter on the technique of the various operative procedures applicable in the surgery of these various organs.

As a whole, the volume mirrors a thoughtful consideration of and selection from a mass of literature, as well as an excellent correlation of the facts finally selected. In Chapter I, for instance, there is an admirable dissertation in which the general subject of jaundice is discussed in the form of short, snappy paragraphs, containing all the really valuable information furnished by recent current literature. Likewise, the topic of gall-stone formation is presented in clear, concise, and thoroughly adequate fashion, so that one may weigh rationally the evidence in favor of stagnation or of infection as etiological factors. The chapter on the pancreas is illuminated by a particularly lucid description of acute pancreatitis, a field in which Deaver has had an enviably large clinical and operative experience.

[1] SURGICAL CLINICS OF JOHN B. MURPHY. Philadelphia and London: W. B. Saunders Company.

[2] SURGERY OF THE VASCULAR SYSTEM. By Bertram M. Bernheim, A. B., M. D. Philadelphia and London: J. B. Lippincott Company.

[3] SURGERY OF THE UPPER ABDOMEN, IN TWO VOLUMES. By John B. Deaver, M. D., Sc. D., LL. D., and Astley Paston Cooper Ashhurst, A. B., M. D. Vol. II, Surgery of the Gall-Bladder, Liver, Pancreas, and Spleen. Philadelphia: P. Blakiston's Sons & Company, 1914.

Many who have read the crisp and oftentimes rather sharply dogmatic papers of Deaver will miss, in this volume, the strong personal note so characteristic of him in his interpretation of symptoms as well as in his setting and execution of operative indications.

Only here and there does one meet with unqualified advice as to what a certain symptom-complex means, what must be done to meet it, and when and how it must be done. The book has a more academic tone, as is testified to by the numerous references following each chapter, or, for example, by the statistical résumé (p. 133) of all the reported cases of choledochus end-to-end suture, choledocho-enterostomy, hepatico-enterostomy and hepatico-cholangeio-enterostomy. The size of the volume naturally limits its scope, and as a result the attempt to crowd in too much data results disastrously in places, as for instance in the attempt to crowd a discussion of the moot points of the physiology of the spleen into three and a half pages. Limits of space are also, in all probability, responsible for the omission under the chapters on Spleen, of a discussion of the large cell type of splenomegaly (Gautier type).

Indeed, there is a palpable evidence of crowding and curtailment in many places where one naturally demands fuller information. The symptomatology of traumatic liver abscess and of amœbic abscess is developed and completed in ten or twelve lines, and nowhere is the symptom of pain described in such fashion as to accord it the place it merits as a cardinal differentiating symptom in visceral disease. When one considers the description of pain furnished by Deaver and Ashhurst, in the light of contrast with Moynihan's description of this invaluable symptom, the comparison approaches the invidious.

The chapter on technique is admirably clear and sufficient, and particularly valuable because here the personal note rings loud and true. Under this head one notes that although the authors have described the transverse abdominal incision of Sprengel, they do not recommend its use, even in splenectomy, where it serves a most excellent purpose in cases of traumata to small spleens well bound down by old or recent perisplenetic adhesions.

## BOOKS RECEIVED

Books received are acknowledged in this department, and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

PHARMACOLOGY, CLINICAL AND EXPERIMENTAL. By Hans H. Meyer, M. D., and R. Gottlieb, M. D. Authorized Translation into English by John Taylor Halsey, M. D. Price, $6.00. Philadelphia and London: J. B. Lippincott Company, 1914.

DER CHIRURGISCHE OPERATIONSKURSUS. By Professor Doctor Victor Schmieden. Price, 16 marks. Leipzig: Johann Ambrosius Barth, 1914.

THE INTERVERTEBRAL FORAMEN. By Harold Swanberg. Price $3.00. Chicago: Chicago Scientific Publishing Company.

DIAGNOSIS IN THE OFFICE AND AT THE BEDSIDE. By Hobart Amory Hare, M. D., B. Sc. Philadelphia and New York: Lea & Febiger, 1914.

INFECTIONS OF THE HAND. By Allen B. Kanavel, M. D. Price, $3.75. Philadelphia and New York: Lea & Febiger, 1914.

LEHRBUCH DER CHIRURGISCHEN OPERATIONEN UND DER HAND; KLINISCHER BEOBACHTUNGEN FÜR ÄRZTE UND STUDIERENDE. Vols. 1 and 2. By Professor Doctor Fedor Krause and Dr. Emil Heymann. Berlin: Urban and Schwarzenberg, 1913.

DIEKRANKHEITEN DES NEUGEBORENEN. By Doctor August Ritter von Reuss. Berlin: Julius Springer, 1914.

# CORRESPONDENCE

## STAMM'S GASTROSTOMY

The *Medical News*, September 22, 1894, contained an article written by me under the title "Gastrostomy by a New Method." After reviewing the methods of Hahn, Girard, Kocher, and Witzel, I said: "Some experiments upon dogs suggested to me a plan of procedure based on sound anatomical principles and which, if not better than Witzel's method, is at least equally as good. In the dog the result has met every point it was *a priori* intended to accomplish. The first steps of the procedure are the same as in Witzel's method, an incision about three inches long being made along the left border of the ribs. The point of introduction of the rubber tube is marked with the knife by a slight incision simply through the serous coat of the stomach. Around

this point as a center, and at a radial distance of a little over one inch, a purse-string suture is introduced by means of a straight needle and strong silk, and including only the serous and muscular coats of the stomach. Next, the opening in the stomach for the rubber tube, about the thickness of No. 15 American scale catheter, is made, and the tube is fastened by a silk or catgut suture. The purse-string is now drawn together and there results a double sphincter which will guard against any leakage from the stomach. With about six interrupted sutures I stitch the stomach to the parietal peritoneum, and both ends of the purse-string suture, which so far served to hold and steady the stomach, are now armed with needles and passed through the entire thickness of the abdominal wall on both sides of the wound, and then tied in a loop. This arrangement will anchor the stomach firmly in position, and the suture can be removed in eight or ten days." This description was accompanied by an illustration showing the tube and purse-string suture. The *Zentralblatt für Chirurgie*, No. 49, p. 1202, 1894, gave a short description of it. Short mention is also made in "Bryant's Operative Surgery," 1901. Binnie, in his "Operative Surgery," also mentions it under the name Stamm-Kader operation. The fact is that Kader of Germany published a method in *Zentralblat, für Chirurgie*, July 11, 1896, nearly two years after my publication, which had one point in common with mine, namely the perpendicular insertion of the tube; but he used interrupted sutures.

Later on, some authors used the purse-string suture and gave Kader credit for it, i.e., Kocher and Bier, in their works on operative surgery. Moynihan, in Kelly-Noble's "Gynecological and Abdominal Surgery," describes and pictures a method which deviates very little from the one I published, and calls it Senn's method. Hermann Fischer of New York, in *Zentralblatt für Chirurgie*, No. 47, 1913, speaks of a Kader-Senn gastrostomy. I am unable for the present to find out what technical steps this joint method represents. About two years after publication of my method, E. J. Senn described a method in the *Journal of the American Medical Association*, p. 1143, November 28, 1896, with the following steps: The stomach is seized as near the great curvature as possible and a cone is formed by an assistant, who holds the apex with his fingers or tissue forceps. Two puckering strings of heavy chromicized catgut are placed parallel to each other about two and one-half inches below the apex of the cone; these sutures include the serous and muscular coats of the stomach. These sutures are next drawn taut and tied, forming a constriction or neck. This end may also be accomplished by folding the stomach by Lembert sutures, but requires more time. Next a portion of the gastrocolic omentum is brought up and a cuff is sutured with fine silk over the constriction. The second stage is done at this time or can be deferred forty-eight hours, until adhesions are formed. This consists of an incision about one-half inch in length in the center of the portion of the stomach exposed. A rubber tube is inserted through this opening into the stomach. The stomach wall is now inverted, forming a circular valve. The inversion is secured by Lembert sutures of silk, etc.

If I understand this method correctly, the cone is not inverted into the lumen of the stomach, but simply the lips of the apex, after the incision, are turned into the lumen of the cone outside the constriction. William J. Mayo seems to understand it in the same way, as he wrote to me a short time ago, saying: "Your method is an exceedingly valuable one, and, so far as we know, is used more than any other. I find it very often erroneously referred to by a good many men as the Senn method. If you will remember, Senn's operation consisted of a nipple toward the outside instead of toward the lumen of the stomach."

It is not my intention to enter into a war of priority or to detract from the merits of the methods of other men. But for the sake of historical accuracy, and since it is the fashion to connect the name of the originator with his method of operation, I think gastrostomy with vertical insertion of the tube and inward folding of the cone of the stomach, with purse-string suture, should be called Stamm's gastrostomy, as no other similar method was made before.

M. STAMM, M. D., Fremont, Ohio

Fig. 28.

Fig. 20.

Fig. 11.

Illustrating article, "The Influence of Ectopic Pregnancy on the Uterus, with Special Reference to Changes in Its Blood Supply and Uterine Bleeding," by John A. Sampson, page 587.

SURGERY, GYNECOLOGY AND OBSTETRICS

AN INTERNATIONAL MAGAZINE, PUBLISHED MONTHLY

VOLUME XVIII MAY, 1914 NUMBER 5

# THE DIFFERENCE BETWEEN THE OLDER AND THE NEWER TREATMENTS BY X-RAY AND RADIUM IN GYNECOLOGICAL DISEASES[1]

BY GEHEIMRATH PROFESSOR DOCTOR KRÖNIG, FREIBURG, GERMANY

I WISH briefly to sum up the indications for röntgen treatment of myomata of the uterus. Röntgen treatment is indicated for myomata in all cases of women of forty years or over in place of the total extirpation of the genital organs or in place of the supravaginal removal of the uterus. This röntgen treatment is preferable in my opinion, first, because it causes no deaths; second, because it can be used even after serious weakening from the loss of blood, and in cases of heart troubles. I also mention the disadvantages of this mode of treatment. First, the greater expense; second, the longer time required by from six to eight treatments extending over a period of three to four months. In cases of younger women whose menstruation and fertility must be preserved, we prefer operation and enucleation, where possible, to röntgen treatment. It is to be regretted that long experience shows that after the enucleation of myomata recidives often occur and bleeding starts afresh after but a short interval. As experience shows that permanent success can be looked for only in cases where the tumors are isolated; there arise a large number of cases, the majority in fact, in which even in women under forty röntgen treatment is indicated in preference to operation.

I do not wish to refrain from mentioning the fact that röntgen treatment harbors a certain danger that arises from uncertainty of diagnosis. Ovarian tumors cannot be reached by röntgen treatment and must be excluded. In some cases tumors of the uterus have grown together with tumors of the ovaries, making differential diagnosis impossible. In these cases operations must be performed. Another difficulty arises from mixed tumors where myoma exist in combination with sarcoma or carcinoma. Carcinomata, arising from the mucous membrane, as they do, can be revealed by curettage and microscopic examination.

Sarcoma of the wall cannot be diagnosed by curettage. This difficulty has been emphasized by those who oppose röntgen treatment as a ground for universal use of the operation.

From the clinic of Professor Bumm at Berlin there appeared recently a treatise in which the frequence of sarcoma was stated as ten per cent of all tumors of the uterus. This high percentage must be the result of accidental causes that are by no means normal. The investigations of others and especially the fundamental work of Cullen and Kelly, in which the whole literature of all countries bearing upon this subject has been brought

[1] Read before the Clinical Congress of Surgeons of North America, November, 1913. Also read before the Chicago Gynecological Society, November 15, 1913. (See discussion, p. 649.)

together with a most wonderful thoroughness, establishes the fact that sarcoma occurs only in one per cent of all cases of tumors of the uterus.

For the clinic at Freiburg, our pathologist, Professor Aschoff, examined microscopically a series of four hundred tumors of the uterus that had been previously removed by me. He found sarcoma present in approximately one per cent of the cases. The apparent danger is minimized by the fact that sarcoma occurs in but one per cent of the cases.

Further, it must be borne in mind that it is by no means uncertain that röntgen treatment will not influence sarcoma-cells in exactly the same way as the myoma-cells. As I reported at the previous meeting, we treated a series of 350 cases of tumors of the uterus with röntgen rays, and all were successful in stopping the bleeding and the reduction in the size of the tumors, and so far as we are able to ascertain, there has been no relapse. In accordance with the previous statistics showing one per cent of sarcoma we should expect in this series three or four cases of sarcoma. Since no tumor grew during treatment or afterwards so far as we could ascertain, it must be assumed that the three or four cases of sarcoma to be expected if they actually occurred were cured by the röntgen treatment.

I believe that I have defined the broad limits for the use of röntgen treatment as against the operative treatment. Dr. Gauss will speak about the technique of the treatment. I cannot, however, close this short discussion without first mentioning the fact that röntgen rays and radium, while valuable and effective, are also dangerous, when used without proper precautions. It requires considerable experience to obtain good results.

As I am speaking to an audience of obstetricians and gynecologists, I will, with the permission of the president, spend a few minutes in discussing an obstetrical procedure, in which we at the Freiburger Clinic have taken an especial interest. I mean the securing of painless delivery by the use of scopolamine-morphine seminarcosis. This special phase of narcosis we have named "Dämmerschlaf," which translated into English would be "twilight sleep." Our clinic has experience covering three thousand births effected under the influence of this drug.

The desire to lighten the pains of parturition is inherent in all civilization that is worthy of the name. With the increasing demands of brainwork naturally goes a keener sensitiveness to all shocks which may accompany pregnancy, and, therefore, to the shocks given by pains. If we hear to-day that it is just in the very civilized and cultivated circles that so great a number of women undergo difficult and surgically-assisted parturition, we know that the cause is not to be sought for in the fact of greater resistance owing to narrow or contracted pelvis nor in the failing activity of labor pains and lack of muscular power. We all know that narrow pelvis is particularly rare in the better classes and also that owing to the prevalence of sport, muscular weakness in the upper classes is very seldom met with. The great number of operative deliveries is to be accounted for by the fact that modern woman has not the strength to resist the nervous exhaustion which is caused by the apperception of pains. We do not deny that by means of narcotic inhalations, chloroform, ether, and laughing-gas many cases in childbirth can be painlessly delivered. Nevertheless these measures are not quite satisfactory. First, because they make such great demands upon the obstetrician, and, secondly, when persevered in for a considerable time they materially diminish the efficacy of the labor.

In our clinic, my assistant, Dr. Gauss, has worked out a method with the use of narcotic injections of scopolamine and the observance of quite definite measures, which we have found to answer excellently in a series of about three thousand deliveries. This method rests upon the administration of a seminarcosis, a state of "Dämmerschlaf;" *i. e.*, a state during which the woman concerned has indeed a perception of pain, but not an apperception. She still reacts to the labor-pains with an expression of pain, but afterwards she has no recollection of the pain experienced.

Scopolamine-morphine is given in small

doses, frequently repeated as a hypodermic injection. The entire technique depends upon the dosage. Two opposite extremes must be avoided: if too much is given in order to bring about a full narcosis from which all expression of pain is absent the labor pains cease, and there arises the danger of atonic bleeding. On the other hand, if too little is administered the pains are perceived and also apperceived. They are remembered, and the nervous exhaustion which this narcosis is designed to avoid arises as if no narcosis had been induced. Between these two limits lies the region of "twilight sleep." You all know this condition. When you give a few drops of ether at the beginning of each labor pain there arises a condition akin to drunkenness, the patient cries, gives expression to pain, but afterwards remembers little or nothing; identically the same condition can be brought about by the injection of scopolamine-morphine, or, as we have latterly learned, by scopolamine-narcophine.

The quantity given must be regulated by a psychological index, namely, by frequently repeated tests of the memory, for it is a peculiar quality of the alkaloid of scopolamine that affects memory in such an intensive and peculiar way. The tests begin after the first two standard doses which are given after an interval of three-quarters of an hour. The first dose 0.00045 scopolamine combined with 0.03 of narcophine, the second dose 0.00045 of scopolamine alone. Half an hour after the second dose, the woman is asked whether she remembers that half an hour previously she was stuck with a needle, or that she saw a watch or some other object that was shown to her at that time. If she remembers, the desired effect has not yet been achieved; if however, she does not remember, she has passed into the desired condition of semi-narcosis. The tests are repeated at intervals of a half-hour and when the recovery of memory occurs the injections are repeated as needed. Recently we attempted to bring about a standardization of the dosage of this "twilight sleep" in order to simplify the procedure. We were able to begin this only after we had gathered a very large experience and after Professor Straub had succeeded in providing scopolamine of uniform and standard strength. In a series of one hundred fifty cases we found that when the dosage and time of scopolamine were regulated in accordance with the schedule posted on the wall, in the cases of women of average strength and good health the desired degree of narcosis resulted.

We believe on a basis of our experience with over three thousand cases in which no detrimental results ever occurred for the mother that we are safe in recommending this drug as not dangerous to mothers. It must be admitted in some cases the frequence of pains is slightly reduced, but our calculations show that the average duration of birth has been increased by only half an hour. We do not want to omit mentioning the disadvantages of this procedure.

The disadvantages of this method consist in the fact that with some women, especially when the surroundings are not very quiet, transitory states of confusion of mind and excitement occur. These are of no material importance, so long as the relations of the mother do not remain in the room, for these states of excitability make an unpleasant impression on the family. In consequence of this, we only carry out the method of "twilight sleep" in cases where the relations promise to be out of the room during the whole time of the birth.

A further disadvantage of the method is that, owing to the absorption of the tiniest amount of scopolamine and narcophine by the child, occasionally an apnœa sets in during the first moments of its life outside the womb and the child only begins to breathe after a certain time, by the operation of the carbonic acid gas.

We must assume, as would happen in the case of any other narcotic, a temporary passage of the scopolamine through the child's body during birth, yet Holzbach's experimental investigations have shown that the scopolamine, of which only the most infinitesimal traces were present, is completely eliminated from the body in the urine within two hours after birth. It is, therefore, justifiable to assume that any action on the child is practically negligible. This is confirmed by the fact that the child mortality at birth has

not increased in the least, and indeed if anything has diminished. If in spite of this we have touched upon the question of the after-effects of scopolamine, we have done so with the object of taking into consideration as far as possible every conceivable disadvantage to the child. Hoche, of the Department for Mental Diseases of the University of Freiburg, who has an extremely wide experience of the action of scopolamine, has on theoretical grounds repudiated the idea that injurious effects might first make their appearance in the child years later. We did not, however, content ourselves with these theoretical considerations. The most exhaustive inquiries were made regarding five hundred children one year old, who at their birth had been exposed to the action of scopolamine and we succeeded in tracing four hundred and twenty of them. Eleven per cent had died in their first year. This is a very favorable figure, when we consider that the death-rate for children under one year old in Baden is identical. We are certainly justified in concluding from this that children in the year immediately following their birth experience no ill effects from the scopolamine administered to their mothers.

The great number of cases has, I think, provided a proof that the small quantities given by us of scopolamine and morphine or narcophine eliminates all probability of danger for the mother, and also, as I have just explained, for the child. The decreasing capacity for resisting pain shown by cultured, civilized women seems to us urgently to call for measures which can reduce the pains of childbirth.

---

# THE TREATMENT OF BLOOD-VESSEL INJURIES[1]

By W. W. GRANT, M. D., Denver

I AM encouraged to present this subject for consideration chiefly because of its seeming neglect, and the absence of any approach to uniformity, or the application of scientific surgical principles to the treatment of hæmorrhage and its common sequel, shock, by a good many men who are doing surgical work. I wish to acknowledge, in the preparation of this paper, my indebtedness especially to the recent work of Stevenson, "Wounds in War," "The Surgery of the Vascular System," by Burnheim of Johns Hopkins, Lejars' "Wounds and Ruptures of the Great Vessels," and Lexer Bevan, "Surgery."

Not a year passes that every active surgeon does not know of the sacrifice of limb or life by an untimely or unnecessary operation from injury, or from hæmorrhage from a damaged blood-vessel, or shock from secondary hæmorrhage from not ligating or suturing the injured vessel. Necessarily the conditions come under the head of urgent surgery, which demands ready wit and prompt, skillful, yet deliberate, action on the part of the surgeon. There is no more severe test of his judgment than the action required to arrest dangerous hæmorrhage. In the embarrassment and confusion of the environment and attendant circumstances, the doubtful or wrong thing is not infrequently done. In military action, eighty-five per cent of the deaths on the field are due to hæmorrhage.[2] The smaller the bullet and the greater its velocity, the cleaner the cut, or wound, of the vessel, whether at right angles to the vessel, or tangentially; therefore, the greater, or more profuse, the hæmorrhage. If the vessel-wall is grazed or contused, the danger of secondary hæmorrhage from sloughing is great. If the coats of the vessel are only partially severed, the hæmorrhage is more severe and dangerous than if the entire continuity is divided. In the former, retraction and contraction are inhibited; in the latter, the reverse, the elastic intima, especially, contracting and receding to a greater extent, a condition favoring the

[2] Wounds in War, p. 117. Stevenson.

[1] Read before the Western Surgical Association, St. Louis, Mo., December 19, 1913.

rapid formation of thrombus. As shock aids the coagulation, by lowering the blood-pressure and impairing the vascular tonus, its first effect is *conservative*, in the arrest of primary hæmorrhage. Lacerated vessels bleed less than clean-cut wounds. Secondary hæmorrhage in a clean wound will not occur if both sides of the wounded vessel are ligated, or sutured, at the seat of the injury, primarily. In the establishment of collateral circulation, there will be recurrence of hæmorrhage from the distal end of the injured vessel if it is not ligated or sutured. In the medical records of recent wars, the mortality from ligation at the site of injury for secondary hæmorrhage is much less than from any form of compression or amputation, varying from forty-three per cent in our own Civil War to twenty-five per cent in the Boer War. The Hunterian operation is more unsuccessful and fatal, the mortality being thirty-six per cent in secondary hæmorrhage. Notwithstanding the axiomatic principle that general anæsthesia and the trauma of operation should not be superadded to the severe shock already existing, it is too often, for different reasons, not respected or recognized in practice. In civil practice, the procedure should be different from that which may be perfectly justifiable in military surgery. The better environment and equipment of the former imperatively demand more conservative methods, and when necessary, or advisable, the more elaborate and available technique.

When the caliber of a large artery, with or without its companion vein, of the extremities is opened by a bullet, or sharp instrument, free immediate hæmorrhage results. The sharper and smoother the instrument, the greater the hæmorrhage. When not immediately fatal, the patient is in severe, if not profound, shock. The first duty of the surgeon is to immobilize the limb and use the ordinary methods of compression to control hæmorrhage, temporarily, and then to devote his energies to the promotion of reaction by external heat, salt infusion by rectum, or venous transfusion, and, if loss of blood and severity of shock justifies it, direct blood transfusion as perfected by Crile, and the use of such heart stimulants as one's experience may justify; but it must not be forgotten that the most urgent and necessary heart stimulant is a fair volume of blood in the arteries. The heart beats will not be quickened nor strengthened unless the vessels are adequately filled with serum or normal blood.

When reaction is established, the second consideration is to prevent an immediate recurrence of the hæmorrhage, also the danger of secondary hæmorrhage at a later date, usually from the fifth to the tenth day. Any method of treatment which does not involve, or include, as a necessary requisite operation on the damaged vessel itself, suture or ligation at the seat of injury, will be dangerous and frequently fatal to the integrity of life or limb. In a ragged wound, the thrombus is more rapidly formed at the site of the injured vessel. It becomes partially organized and temporarily plugs the vessel. As the volume of blood is restored, the thrombus cannot be relied upon to resist the *vis a tergo*, or increased heart beats, until well organized. As a result, a clot is generally dislodged and, in some cases, conclusively indicated by a little fresh arterial blood from the wound within a week, which is a forerunner of more severe hæmorrhage to follow. At this stage the embarrassments and difficulties are greater than in the primary hæmorrhage, and, for its treatment, requires prompt, acute surgical judgment as well as skillful surgical technique.

Carrel has demonstrated that a circular end-to-end suture of an artery is not followed by either secondary hæmorrhage or aneurism. Its success in the human subject has been repeatedly demonstrated. The first arterial suture was by Hallowell in 1759. Horach was the first to try an end-to-end suture in 1888. Abbe succeeded in using a glass bobbin in 1894 which was afterwards elaborated by Murphy with the first circular suture in 1897, and Carrel's teacher — Jaboulay, and Briau, while the first arteriovenous anastomosis was by Hubbard in 1906 for gangrene of the leg. "If the artery is essential to the life of the part which it supplies, it should be closed by end or lateral suture, depending

upon the character of the injury. If not essential, it may be ligated above and below the point of injury.[1]" "If the diagnosis of injury to an artery is made, with or without simultaneous injury of a vein, the point of injury should be exposed, even if there is no external hæmorrhage, blood-clots removed, and the vessel ligated or sutured.[2]"

Besides the local and general condition, the application of a stethoscope to the seat of injury will aid in the diagnosis by revealing a blowing sound, or bruit.

Gangrene of leg follows 50 per cent of cases of ligation of the popliteal artery, 20 per cent of the femoral, 50 per cent of both femoral artery and vein, 1 to 2 per cent of the femoral vein alone.[3] "It must be accepted as a maxim that the preservation of the blood and nerve supply, rather than the condition of the bone and soft tissues, is the most important consideration in the preservation of the limb. Primary amputation is indicated only when the principal vessels and nerves are involved with extensive destruction of bone and soft parts.[4]

The occlusion of the axillary, the brachial, the femoral, and popliteal may not be considered fatal to the nutrition and preservation of the limb distal to the injured part, but the integrity of these vessels is so necessary and important that the condition should be treated as if they were absolutely essential to the preservation of the limb. The first consideration, after reaction, should be, in case of injury to such vessels, to explore the wound, guided by the track of the bullet or implement to the seat of injury, and the vessel treated in accordance with the equipment and technique fully described by Carrel or Burnheim.[5] This is the ideal treatment, but in the absence of the necessary equipment and conditions for its performance, the next step, which should be imperative, is ligation of the vessel both above and below the point of injury. If the former is done, the blood supply is restored to the limb and gangrene will not result, especially in the absence of infection. If ligation is employed, which is the classical method in military surgery, and heretofore in civil practice, the preservation of the limb depends upon the establishment of the collateral circulation, and the success of this depends partly on the location of the injury, as well as upon the immediate attendant conditions, general as well as local. In the majority of cases, the result will be favorable. If infection and gangrene occur in these injuries, the limb distal to the injury will probably be lost. If partial or localized gangrene only occurs, it is still possible to save the limb by suture of the vessels or reversal of the circulation. If neither suture of the vessel nor ligation is employed, secondary hæmorrhage becomes a menace of such momentous importance and danger as to threaten the rest and conscience of the surgeon, for it will come with the suddenness and force of an explosion. Infection increases the probability and danger of secondary hæmorrhage. In the absence of infection especially, the patient should have the benefit of the same conservative treatment as in the primary. If infection exists in the absence of gangrene, ligation is probably the operation of choice; but if the primary injury and hæmorrhage are treated in accordance with the principles and technique of modern surgery, secondary hæmorrhage will be rare, consequently will not so frequently, as now, demand the consideration of the surgeon. If both artery and vein are injured, the difficulties and dangers are greater, just as it is when both are involved in aneurism.

In thrombus, with partial or threatened gangrene, reversal of the circulation is promising of better results, and the lateral arteriovenous anastomosis of Burnheim seems to possess advantages over the end-to-end anastomosis of Carrel.

In this paper, it is not my purpose to more than allude to the concealed, or intra-abdominal, hæmorrhage from bullet or stab wounds, nor from the impact of heavy, or falling, bodies on the abdomen. In these injuries there is not only frequent and dangerous hæmorrhage, but the added danger of extravasation of the visceral contents. Such

[1] Lexer, p. 537.
[2] Lexer, p. 555.
[3] Lexer, p. 489.
[4] Chaumel and Minier. Stevenson. Wounds in War.
[5] There is a good bibliographical chapter in Binnie's Operative Surgery.

injuries are almost uniformly mortal within forty-eight hours, in the absence of prompt operation; nor in view of the location of the injury is it safe to defer an exploratory operation long, in the presence of persistent shock, for the latter indicates continuous hæmorrhage or extravasation, or both. But it is to be remembered that when profound anæsthesia and the trauma of operation are added to the existing shock, we have made a favorable result not only much more difficult, but often impossible. Under the conditions of such injuries, it is better and wiser as a rule not to employ general anæsthesia at all, though full consideration should be given to nitrous oxide and oxygen in preference to others.

Local anæsthesia may be used to advantage in many such cases, and it should appeal to the surgical judgment in the shock and prostration from primary or secondary hæmorrhage.

It sounds the recall of a fundamental principle to protest against its frequent violation in shock and first aid to the injured; and to protest the needless sacrifice, the greater because of the silence of so many teachers and leaders of opinion.

"Shock is exhaustion of the nerve-centers." (Crile.)

"Shock is inhibition of the activities of the nerve centers." (Meltzer.)

"Shock is loss of vasomotor control, due to hæmorrhage and to afferent peripheral impulses, such as trauma to the visceral peritoneum." (Janeway.)

"Shock is due to a reduction of the dioxide blood-content, and to impaired vascular tonus." (Henderson.)

Regardless of the cause and the definition, it is always a serious condition, and a problem of important significance to the surgeon.

## CONCLUSIONS

We reaffirm the conclusion that general anæsthesia and operation in grave shock from injury and hæmorrhage is indefensible; that the first effect of shock from hæmorrhage is conservative, in promoting the rapid formation of thrombus and arresting bleeding, probably from impaired nerve and vascular tonus in reducing blood pressure, and depressing the action of the heart; that reaction should be awaited and the interval used in promoting it by well-known methods.

If reaction should *not* occur in a reasonable time, depending on, or influenced by, the nature of the accident and the previous state of the patient, ether and the trauma of operation would only aggravate the condition and render recovery still more doubtful. If, with reaction, the damaged vessel is not operated on, it will be wise not to stimulate the heart prematurely but rather keep it mildly subdued in order to give sufficient time for the thorough organization of the thrombus, as, without suture or ligation, it is the chief obstacle to secondary hæmorrhage. When reaction is assured, the damaged vessel—such as axillary or brachial, the popliteal, or the femoral—should, under local or general anæsthesia, be preferably sutured, secondly ligated, without needless delay. With successful suturing of the vessels, nutrition of the parts is preserved and gangrene prevented. With ligation, the collateral circulation will, in a large proportion of cases, preserve the nutrition and integrity of the parts; but it is more uncertain than suture, but more reliable than other measures.

Amputation has no place in modern civil practice as a remedy for traumatic hæmorrhage, and a smaller place in the military surgery of the future among civilized nations than in wars even of the recent past.

# SURGICAL REPAIR OF BLOOD-VESSELS: ITS TECHNIQUE, ITS USES, AND LIMITATIONS[1]

By J. SHELTON HORSLEY, M. D., Richmond, Virginia

SUTURING blood-vessels was first put on a satisfactory basis by Carrel, who established the principle that successful suturing depends upon the approximation of intima to intima with a minimum amount of injury. The chief difficulty to overcome is occlusion by clotting, and improvements in technique are intended to prevent an excessive amount of clotting. The physiology of thrombus formation is still rather vague, as it is impossible to isolate chemically some of the substances that are involved in this process, and their presence has to be taken for granted in order to support a reasonable hypothesis. There are certain general reactions, however, that all physiologists agree to. The direct formation of a thrombus is due to the action of fibrin ferment on fibrinogen. Fibrinogen exists normally in blood plasma. Fibrin ferment is built up from various substances and is probably formed from the action of a thrombo-plastic substance, called by some thrombokinase, upon thrombogen in the presence of a solution of calcium salts. Thrombokinase is not a true kinase in the sense of acting solely as a ferment, for it is used up in the process of clotting. Thrombokinase is the key to the situation, and whether it acts directly, or indirectly, as Howell claims by combining with antithrombin in the blood and thus liberating prothrombin (thrombogen), it nevertheless is essential to clotting and to a large extent regulates the quantity of thrombi formed. Thrombokinase is supposed to be present in all tissues of the body and also comes from disorganized blood-corpuscles, particularly the platelets. It seems abundant in the adventitia of blood-vessels.

The practical bearing of these facts upon blood-vessel surgery is very evident, for thrombokinase can only be liberated from injured tissue. As the amount of clotting is directly proportionate to the amount of thrombokinase, it is readily seen that any undue injury to blood-vessels by rough handling, or by drying of the endothelial cells of the intima, or by the presence of too much foreign substance in the lumen, or by chemical or bacterial injuries, will result in the liberation of so much thrombokinase that there is excessive thrombus formation and the vessel is occluded. Even the most successful suturing of blood-vessels is accompanied by some clotting, but a limited amount is essential as it serves to fill the punctures from the needle holes and to bridge over the line of contact. In successful vessel suturing, however, the injury is so slight that very little thrombokinase is released and consequently there is only a small amount of thrombus formation, just enough to plug the punctures made by the needle and not enough to occlude the lumen.

We recognize, then, as the principles for successful blood-vessel surgery that a continuous surface of vascular endothelium must line the lumen and that as little injury as possible must be done this endothelium. The importance of presenting to the lumen of the vessel a continuous surface of vascular endothelium is appreciated when we recall what has been learned in a somewhat coarser fashion by intestinal suturing. Here it is a well recognized principle, as it is in blood-vessel suturing, that the endothelial surfaces must be approximated accurately. In the case of the bowel, the endothelium is on the *outside* and it is necessary to turn *in* a small flange or shelf to secure accurate apposition of the peritoneal endothelium. In blood-vessels the endothelium is on the *inside* and it is essential to turn *out* a flange in order to approximate the endothelial lining of the blood-vessel. The usual method of suturing blood-vessels consists in first placing three guy sutures and then whipping the edges of the vessel together by an overhand stitch. This necessarily cannot approximate the

[1] Read before the Southern Surgical and Gynecological Association, Atlanta, Georgia, December, 16, 1913.

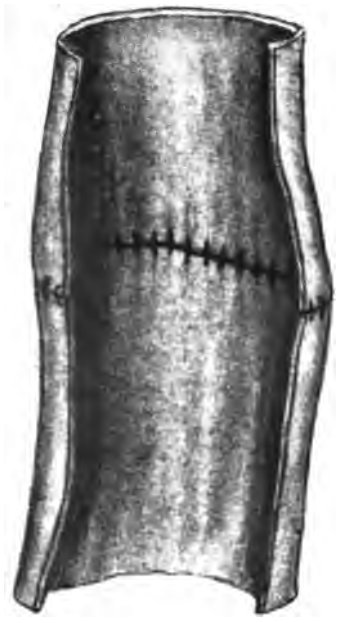


Fig. 1

Fig. 2

Fig. 3

Fig. 1. This drawing, reproduced from Guthrie, shows the appearance of the lumen of a blood-vessel immediately after it is sutured by the method of Carrel. Note the large amount of thread exposed in the lumen.

Fig. 2. This drawing, also from Guthrie, shows the appearance of the lumen of a blood-vessel several weeks after successful suturing. The stitches have been covered by endothelium which is still partly transparent. The older the specimen, the thicker and more opaque becomes the covering over the sutures until after several months the stitches are completely hidden from view. This is true of any method of suturing whether the mattress or overhand stitch is used. It is the first day or two after the suturing before the stitches are covered over that the amount of thread in the lumen is important. Sutures seem to work away from endothelial surfaces toward the lumen in case of the intestine and toward the surface in the case of blood-vessels.

Fig. 3. This drawing shows the eversion of the intima caused by the double mattress stitch and the consequent absence of any raw surface left in the lumen of the vessel. Note the very small amount of thread left exposed to the blood current as compared with Fig. 1. Note also the strong grip that the loop of the mattress stitch has on the tissue.

endothelial surface on the inside as accurately as would a mattress stitch which turns *out* a flange and compels the apposition of the intima. No one would think of suturing a bowel in a similar manner and claim that the peritoneum could be accurately brought together by merely whipping over the margins of the bowel wound as in suturing skin. If this cannot be done in intestinal surgery, the same thing holds equally in blood-vessel surgery.

The presence of foreign substances in the lumen of a blood-vessel promotes clotting. Some substances favor clotting more than others. A coating of vaseline or paraffin retards clotting. Other things being equal, however, the larger the amount of foreign substance or raw surface in the blood-vessel, the greater the likelihood of extensive clotting. A mattress suture which turns *out* a flange not only approximates the intima more accurately but leaves almost no thread exposed in the lumen; whereas the regular overhand stitch leaves a considerable amount of thread in the lumen. This is readily seen from the accompanying cut (Fig. 1) which is reproduced from Guthrie's work on blood-vessel surgery and shows the inside of the vessel soon after being sutured by the usual method. The mattress suture which is parallel to the wound also secures a better hold upon the tissues than the overhand stitch which is at right angles to the wound, and the mattress stitch is consequently less liable to cut.

(Fig. 3.) This is due to the fact that in the mattress suture the tension is more equally distributed along the whole loop of the stitch, whereas in the overhand stitch the tension is concentrated at one point; that is, at the end of the suture farthest from the wound. This fact has been brought out by Lexer[1] in the following case:

Lexer of Jena showed a case of ideal operation for aneurism and transplantation of the vessels. The patient was operated on according to the rules established by Lexer in 1907. To maintain the circulation in its normal channel, the spindle-shaped aneurism beginning above Poupart's ligament and extending below the arteria profunda was removed and the defect of the vessel repaired by the introduction of a piece of the saphenous vein, 18 cm. long. The wall of the artery markedly changed by arteriosclerosis allowed the threads of the running suture of Carrel to cut through. On the other hand, the continuous protruding mattress suture gave very good service; the thread not only held well but also prevented hæmorrhage.

Asepsis in blood-vessel suturing should be as nearly perfect as possible, just as it should be in abdominal surgery, brain surgery, or bone surgery. If the tissues around the blood-vessels are infected no suturing can be expected to be satisfactory. Yet even in the presence of infection it is not invariably a failure, as I have one successfully sutured femoral artery in a dog in which the tissues around the vessel suppurated for several weeks. As a rule, however, infection will result in failure and the proper aseptic technique should be insisted upon. Particularly should dust infection be avoided. The operator should wear a mask over his mouth and the floor of the operating room should preferably be moist. In laboratory work the floor should be flushed with water an hour or two before operating. The manner of handling tissues is most important, for gentleness is an absolute essential. No matter how careful the aseptic technique, good results cannot be secured by one who uses the same methods of handling tissue in blood-vessel surgery as would be adopted in bone surgery. The vascular endothelium should not be permitted to dry and should not be touched with any instrument.

As for instruments, I use No. 16 straight needles threaded with ooooo twisted black silk. They are threaded with silk about 14 inches long and a single knot is tied on the eye of the needle to prevent it becoming unthreaded. The short end should be cut within half an inch of the needle to avoid unnecessary loose ends dangling about. Five of these threaded needles are run through a piece of gauze of double thickness about two inches wide and as long as the thread. This gauze is then placed in a small can or ointment jar that is one-third full of white vaseline. More vaseline is put over the gauze and the jar is fastened and sterilized. The needles are not removed until they are to be used, when they are taken from the gauze, and the gauze, which is thoroughly impregnated with vaseline, is laid beneath the artery to protect it from the surrounding tissue. It is necessary to have the arterial suture staff which has been fully described in other publications. It consists of two small shafts of steel united by a spring so that the short shaft forms an angle of about 60 degrees to the long shaft. There are two buttons on the end of the short shaft, two about opposite to these on the long shaft, and one near the spring on the long shaft (Fig. 4). In order to occlude the vessel, either a rubber covered Crile clamp is used, or the ordinary serrefine, or bull dog clamp, uncovered, which has a spring so weakened that the clamp can grasp the skin of the forearm without pain. The inside of the vessel should never be seized with forceps, though sometimes it is necessary to grasp the outside. For this purpose the ordinary thumb forceps called "frog forceps" by the instrument dealers and sold for biological dissection are excellent. Several mosquito hæmostatic forceps are often needed. Aside from these special instruments, the usual instruments may be employed. The knife and scissors should be sharp.

The vessel is exposed, keeping the tissues as dry as possible. A serrefine is placed on the portion of the vessel nearest the heart, and the vessel is then gently grasped between the thumb and finger and stripped of blood to the other angle of the wound, where another serrefine is placed. This leaves the artery dry and flat like a ribbon. The vase-

[1] J. Am. M. Ass., 1913, May 10th, 1474.

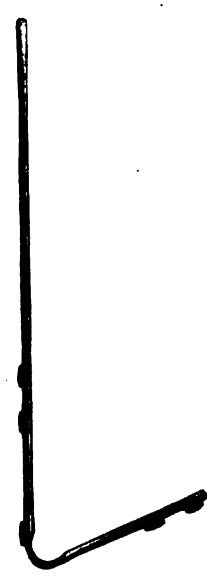


Fig. 4

Fig. 5

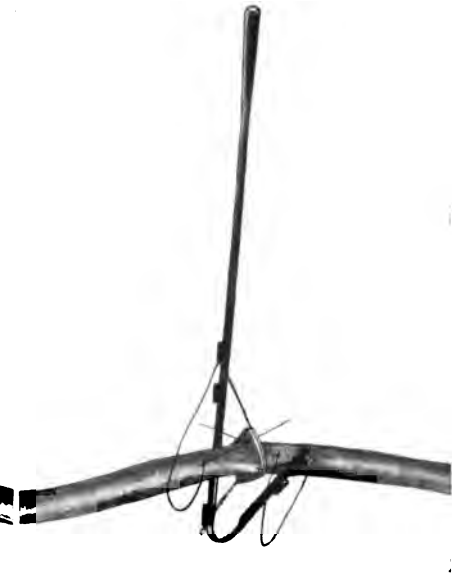


Fig. 6

Fig. 4. The arterial suture staff. For description see text.

Fig. 5. The three guy sutures have been placed and fastened to the buttons on the staff. The threaded ends from the last two sutures are left long for further suturing. The circumference of the vessel is made triangular and the intima is everted by the tension of the spring of the suture staff.

Fig. 6. The handle of the staff is upright and the whole instrument is lifted up somewhat to increase the eversion of the intima. The continuous double mattress, or cobbler's stitch, has been started using the threaded ends from the last two guy sutures. The needles are thrust through the margins of the artery near the insertion of the second guy suture. The needles should be inserted at about right angles to each other so they can be handled better. The suturing in this third is done toward the operator, that is, from the second to the third guy suture.

linized gauze from which the needles have been removed is now placed beneath the vessel, after stopping all bleeding in the wound, and the artery divided with one stroke of sharp scissors. The fingers are wiped free of blood and moisture on a dry towel and the left finger and thumb grasp one of the ends of the artery rather firmly and pull the adventitia over its cut end. The adventitia is cut off on a level with the rest of the artery. It then retracts, leaving the middle and inner coats exposed. Any remaining clots in the vessel are stripped out with the thumb and finger and the end is held firmly between the thumb and finger of the left hand and sponged with dry gauze. As the artery is collapsed and its end held between the finger and thumb the gauze cannot touch the intima but merely wipes the wounded portion and so removes any excess of thrombokinase. The tip of a finger of the right hand is then dipped in white vaseline and the end of the artery is smeared over with vaseline immediately after being sponged. This serves to keep back any further juices from the severed artery and also prevents drying of the intima. The other end of the vessel is treated in the same manner. All of these manipulations are done rapidly for it is essential to complete the suturing as quickly as possible after the intima has been exposed. One of the sutures which has been prepared as directed is inserted from without inward at one end of the artery and from within outward at the other end. No more of the vessel wall should be grasped than is necessary to secure a fairly good hold. An artery is quite tough and a small bite will be sufficient. If too much is taken, the intima cannot be properly everted. The first loop of a knot is tied, bringing the ends of the vessel together. The second loop of the knot

Fig. 7. The handle of the staff is depressed until it is horizontal and points away from the operator. The whole instrument is shoved toward the operator so as to increase the eversion of the intima in the second third. The suturing is continued as a cobbler's stitch.

Fig. 8. The handle of the staff is then brought over to a horizontal position pointing toward the operator. The instrument is lifted up so as to increase the eversion of the last third. The suturing is continued toward the second guy suture.

is tied while holding the ends of the suture taut, running the knot down in this manner so as to prevent the first loop from slipping. After tying this suture, the arterial suture staff is placed under the artery with the short shaft pointing toward the operator. The guy suture is fastened by wrapping it two or three times around the lowest button on the long shaft. The length of the suture from the button to the vessel should be about half an inch. The second suture is placed about one-third of the way around the circumference of the vessel and should be on the side away from the operator. The suture staff can be laid flat so that the short shaft is not in the way and the vessel ends can rest upon the long shaft, thus making it easier to insert the second suture. The second suture is inserted and tied in a manner similar to the first and is wrapped around one of the upper buttons on the long shaft. The threaded end is left long for future suturing, but the other end is cut close to the button. As two guy sutures are now fixed to the long shaft, the third one is easily inserted by raising up the long shaft when the point of insertion of the third suture is indicated by the retraction of the margins of the artery. The needle is inserted at the apex of the retracted margin. After this suture is tied, the short shaft is slightly compressed toward the long shaft and this guy suture is wrapped around one of the buttons on the end of the short shaft. The threaded end is left long and the unthreaded end is cut close, as in the second suture. It is important to have no unnecessary ends hanging loose. The short shaft is released and the spring makes tension on the margins of the artery, converting its circumference into a triangle, and everting the intima (Fig. 5).

The three guy sutures are inserted in the same way when an artery is united to a vein of much larger caliber, as when a divided artery is united. Sometimes it is a little more difficult when a small artery is united to a large vein, but after the guy sutures are once inserted, the rest of the procedure is identical whether vessels of equal or unequal caliber are to be united. We now have two needles from the guy sutures last inserted. A needle is taken in each hand and thrust through both margins of the artery in the region where the second suture was tied. The threaded needle from the third guy suture at the end of the short shaft will, of course, carry a little loop of thread which is of no consequence. The instrument is lifted up so as to elevate the upper third of the wound and increase the eversion. The suture is then applied in the manner of the double mattress, or cobbler's stitch, going from the second guy suture to the third (Fig. 6). At the angles particular care should be taken to go

beneath the insertion of the guy sutures; otherwise, the tension of the guy sutures may produce a wound in the endothelium which would be exposed to the lumen of the vessel. After the first third has been sutured, the handle of the instrument is depressed away from the operator and the instrument *shoved toward the operator* so as to increase the eversion of this third of the margin of the vessel (Fig. 7). The suturing is continued as a cobbler's stitch. When the second third is finished, the instrument is brought to its original position and each needle carried under the vessel so as to be ready for suturing the last third. The handle is then depressed *toward* the operator and held in such a manner as to lift up the last third and so increase its eversion (Fig. 8). The suturing is continued through the last third and when this is finished the instrument is again brought back to its original position and the suturing carried about two stitches beyond the point of commencement, where the threads are tied to each other. Each stitch must be drawn snugly when it is placed, else the intima will not be securely approximated and there will be leakage. In the carotid of a medium sized dog about five stitches are put in each third of the artery.

Sometimes, particularly in old dogs, retraction of the ends of the artery is marked and the sutures cannot be properly placed as they will tend to cut out or break under the tension. If the adventitia of the vessel is grasped with curved mosquito forceps about one and one-half inches from the severed ends, the two ends of the vessel can be shoved together by an assistant without tension on the sutures and without his hands being in the way of the operator. This is better than trying to approximate the ends by the serrefine clamps which may either come off or loosen and flood the vessel with blood. After the suturing has been completed, the short shaft is slightly compressed toward the main shaft so as to relax the tension on the guy sutures and the *distal* clamp on the vessel is slowly released (Fig. 9). If there is marked spurting at any point an extra suture should be placed there. With a little experience spurting rarely occurs, though there is usually oozing of a few drops of blood. The guy sutures are then cut and the instrument is removed. The sutured vessel is very gently compressed with dry gauze and the distal clamp is entirely removed. After about a minute the proximal clamp is slowly removed. In this time the needle holes should be plugged with fibrin and there should be no leakage. The vessel must not be returned to its bed until leakage has ceased. The whole procedure of suturing the vessel, from the insertion of the guy sutures to the last stitch, can easily be done in from ten to fifteen minutes and often in less time. Any competent surgeon who tries this technique experimentally a few times can master it.

Fig. 9. The handle of the instrument is brought to a vertical position and the threads tied. The distal serrefine is slightly relaxed while the short shaft is pressed toward the long shaft so relaxing the tension of the spring. If any markedly spurting point is seen, an extra suture can be inserted.

This technique has been mentioned in three previous articles.[1] The arterial suture staff has not been altered and the general principle of approximating the intima has always been adhered to. However, a great many details of applying this principle have been changed, and I think these changes add to the

[1] Ann. Surg., Phila., 1912, February; J. Am. M. Ass., 1912, July 6, 4, and December 14, 1912, 2149.

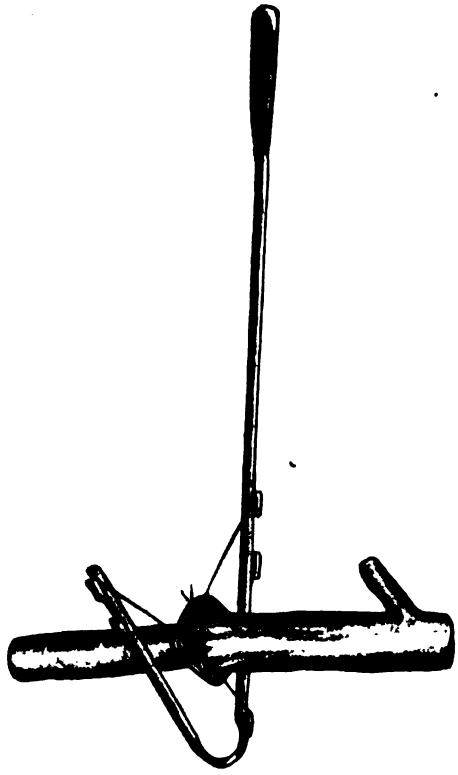


Fig. 10. Showing the method of suturing applied to transfusion of blood. On the right is a vein which is somewhat larger than the artery. The vein has a branch through which a smooth probe covered with vaseline can be inserted and carried up into the artery if obstruction occurs. By pressing on the main trunk of the vein clots are blown out through the branch.

efficiency of the technique. The suture staff, which holds the vessels so that the edges are everted and each stitch is inserted under the *same tension* from the first to the last, greatly facilitates the suturing and makes possible the carrying out of the principles that have already been noted.

The changes from the other publications are as follows:

1. A double mattress or cobbler's stitch is now used instead of the single mattress stitch as originally advised. It was found that when the single mattress stitch was used there were points between sutures with but little compression and no raw surface. This sometimes made a small amount of leakage that was difficult to control; also a little diverticulum would be formed that was

Fig. 11. Showing a piece of rubber tube sutured in between the cut ends of an artery. Note the complete absence of any sharp margin of the tube and the absence of thread in the lumen. This cannot be done by the regular overhand suture.

a weak spot and would occasionally result in secondary hæmorrhage. The double mattress stitch does away with these objections and approximates the intima firmly as by a fine clamp around the entire margins of the vessel and at the same time exposes no more thread in the lumen than is exposed by the single mattress stitch. The use of this stitch can be readily acquired by any one who tries it. It has been most successfully used in intestinal suturing by Crile, and is much more needed in vessel suturing, as there is more pressure in a blood-vessel than in the bowel.

2. No salt solution is now used to wash out the vessels. It has been the object of this technique to eliminate as far as possible every procedure that is not essential to success. Washing out the ends of the vessel with salt solution not only adds somewhat to the trauma of the endothelium, makes a sloppy wound, and prolongs the procedure, but according to Guthrie, rather tends to increase clotting than diminish it.

3. In order to strengthen the second and third guy sutures, both ends of these sutures are now wrapped around the buttons, instead of merely using the unthreaded ends, as was formerly advised. Instead of first inserting the guy sutures and then placing them on the suture staff, it is better to fix them on the staff as they are inserted. This not only relieves the necessity of handling the sutures twice, when once will do, but it is much easier to place the second and third sutures when the first has been fastened to the staff, as the

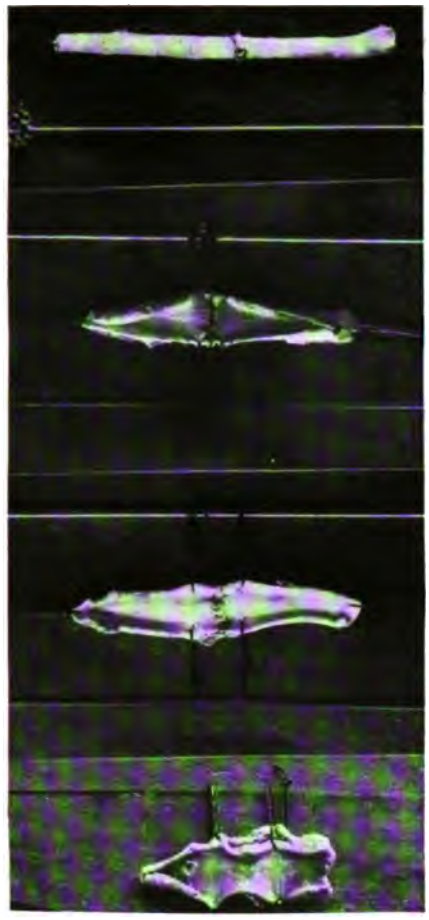


Fig. 12

Fig. 13

Fig. 14

Fig. 15

Fig. 12. Photograph of an iliac artery of a dog which was removed a few minutes after suturing after the blood had been turned on and no leakage appeared. Note the eversion of the intima constituting a flange without diminution of the caliber.

Fig. 13. Photograph of the lumen of carotid artery of a medium sized dog. The blood had been allowed to flow for a few minutes and there was no leakage. Note the absence of thread in the lumen.

Fig. 14. Photograph of a carotid artery 11 days after being sutured. The lumen is smooth. The stitches have stretched and are visible beneath the transparent coating of endothelium.

Fig. 15. Photograph of a femoral artery 33 days after operation. The stitches are barely visible. A small black speck in the upper edge shows the line of sutures. The covering over the stitches is thicker than it usually is in this time, but the specimen illustrates, as compared with previous figure, how stitches are gradually buried.

Fig. 16. Photograph showing external appearance of a section of external jugular vein which was sutured in between the divided ends of a carotid. The specimen was removed 24 hours after operation. It is collapsed and free from clots.

Fig. 17. Photograph of a segment of external jugular vein which was sutured in the place of a resected portion of the right carotid of a large dog. Note the valves about the middle of the specimen in one of which is a small clot. The specimen was dilated at this point probably from the force of the blood stream in overcoming the valves. Otherwise the intima is perfectly smooth and the sutures are mostly buried from view. The specimen was removed 63 days after operation.

Fig. 18. Photograph of specimen of reversal of circulation in the neck. The proximal end of the carotid was sutured to the distal end of the external jugular vein in a medium sized dog. This specimen was removed after 39 days. The sutures are distinctly buried, though the endothelium over them is still transparent at places. The line of suturing is perfectly smooth. A short distance from the line of sutures are the crumpled up valves which were forced and broken down by the blood stream.

staff can then be manipulated so as to bring the margins of the vessel wound into a more advantageous position for suturing.

Sensational newspaper articles have done blood-vessel surgery much harm. The idea that a new limb can be grafted on and will remain useful, or that a kidney or thyroid can be beneficially transplanted from one individual to another is entirely erroneous. None of these experiments, even in animals, has been permanently successful. A kidney transplanted from one dog to another will probably functionate for a while, but sooner or later the fine differences of serum and tissue destroy the organ and prevent permanent

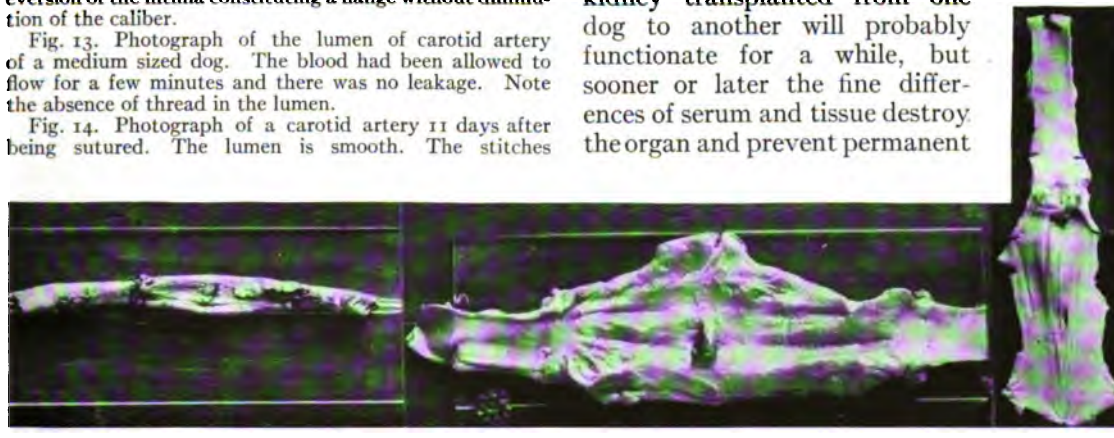


Fig. 16 Fig. 17 Fig. 18

Fig. 19. Photograph of a dog in which a portion of the abdominal aorta was resected and a section of rubber tubing coated with paraffin and vaseline was sutured in to fill the defect. The dog made a perfect recovery. The photograph was taken six months after operation. The dog was killed and the specimen which was removed showed the tube completely encapsulated but occluded. The occlusion had evidently been gradual, as there were no bad symptoms and no paralysis of the legs. A gradual occlusion in such cases which will permit of time for collateral circulation is clinically as satisfactory as if the tube remained permanently open.

success. To quote from the preface to Guthrie's monograph on blood-vessel surgery: "Heterografts succeed at first, but inevitably fail after the first few weeks. This is the disappointing but unanimous conclusion of the experimenters. Thus there is, at present, no temptation for the enthusiastic surgeon to try and graft one lobe of the thyroid or a kidney taken from a healthy donor. The poor man will not be tempted to exchange one of his sound kidneys for so much hard cash."

However, blood-vessel surgery has a very broad field, for while complicated glandular organs do not survive transplantation, a simpler tissue does. A blood-vessel, for instance, can be transplanted from one animal to another and may functionate indefinitely. The four fruitful fields of blood-vessel surgery at present are:

1. Wounded blood-vessels. Here direct suture can be used, or if much of the vessel has been injured, a segment of some vein from the patient's own body, as the saphenous can be sutured in the defect.

2. In excision of malignant tumors which have been heretofore considered inoperable because of involvement of a large blood-vessel, a section of the vessel can be removed and the vessel repaired as for trauma.

3. Aneurisms may possibly be treated in a similar way, though on account of the diseased condition of the vessel wall it is not likely to be so satisfactory as in surgery following trauma. However, several successful cases have been reported, as the case of Lexer referred to above.

4. Transfusion of blood. There are a great many ways of performing transfusion of blood, but probably no method can be quite so ideal as that which permits the flow of the oxygenated arterial blood of the donor directly over an endothelial surface into the veins of the patients. While numerous instruments have been devised for drawing blood from the donor into a receptacle and then injecting it, even in the short space of time when the blood is not in contact with endothelial surfaces there may be some changes that will render it less valuable. Certainly, it is better to have it directly transferred to the venous system of the patient. The various tubes and canulas are often of great service, but if they do not work, the whole operation will have to be done over again.

In the method of suturing just described, when applied to transfusion, a vein should be selected sufficiently large and with a nearby branch (Fig. 10). If for any reason an obstruction occurs at the suture line, the finger can be placed on the main trunk of the vein, and the sutured area gently manipulated between the thumb and finger, when the clot will usually be blown out of the venous branch. If this is not successful and especially if the radial artery from which the blood is taken contracts too greatly, a smooth probe covered with vaseline can be introduced through the venous branch, and carried up through the sutured region into the radial artery. When the probe is withdrawn a full flow of blood follows. It is impossible to do this if a canula has been used. After a probe has been once introduced in this manner, clotting occurs in from five to ten minutes,

but a free flow of blood for twenty minutes is all that is necessary in most cases, and it is better to do this simple procedure two or three times than to perform the whole operation over again. If for any reason the suturing does have to be done again, a small section including the sutures can be removed and will leave enough of the artery and vein to bring together again; whereas, with a canula so much of the artery and vein is tied off that enough will hardly be left for another operation.

The photographs of specimens show some of the work that has been done by this method. A rubber tube has also been sutured in after resection of an artery (Fig. 11). These experiments have not yet been completed and a report will be made later upon this feature. However, I do not believe a rubber tube can be sutured satisfactorily into the defect caused by resection of an artery by the overhand method, as the tube will leave sharp edges of the rubber exposed to the blood-current, whereas the mattress stitch prevents this by everting the edges of both the tube and the artery.

---

# CANCER OF THE BREAST IN A BOY FIFTEEN YEARS OLD[1]

By ROBERT C. BRYAN, M. D., Richmond, Virginia

ONE per cent of all tumors of the breast occur in the male and two per cent of this number are malignant. Poirier, Schuchardt, and Warfield have collected from literature something like 509 cases of carcinoma in the male mammary gland. The age for this condition is apparently a little later in the male than in the female, about 60 years. Trauma is responsible in 13 per cent of female mammary carcinoma and in 50 per cent of the male. Theoretically, the right should be involved more often. Both the right and the left breasts, however, are apparently affected with the same degree of frequency, despite occupation as instanced in shoemakers, engineers, etc.

| | Males | Females |
|---|---|---|
| Total number cases | 90 | 500 |
| 20 to 25 years | 2 | 0.6 |
| 25 to 30 years | 2 | 4 |
| 30 to 35 years | 9 | 6 |
| 35 to 40 years | 12 | 14 |
| 40 to 45 years | 11 | 16 |
| 45 to 50 years | 17 | 20 |
| 50 to 55 years | 15 | 15 |
| 55 to 60 years | 12 | 10 |
| 60 to 65 years | 7 | 9 |
| 65 to 70 years | 3 | 3.2 |
| Over 70 years | 10 | 2.2 |
| Mean age | 50 | 48 |
| Earliest age | 20 | 22 |
| Latest age | 82 | 84 |

It will be seen from this table that the average age at which the disease originates in males is two years later than in females.

It is further noticeable that a relatively large number of the male cases begin after 70 years of age. In most other respects there is remarkable similarity as to the age distribution in the two sexes.[2]

The two greatest extremes in age of cancer of the breast that the writer can find in literature are the following:

Lunn's Case: A man aged 91 years, shoemaker, admitted into Marylebone Infirmary May 22, 1896. Pain in left breast ten months before admission, due possibly to friction of braces. Small scab formed around the nipple. Three months before admission lump in the left axilla. Fungating growth involving nipple and one inch of area. Breast and glands removed. Wound healed by first intention. Death from hypostatic congestion of the lungs a few days after operation. No post-mortem allowed. There were also secondary glandular deposits, rare in cases of duct carcinoma.[3]

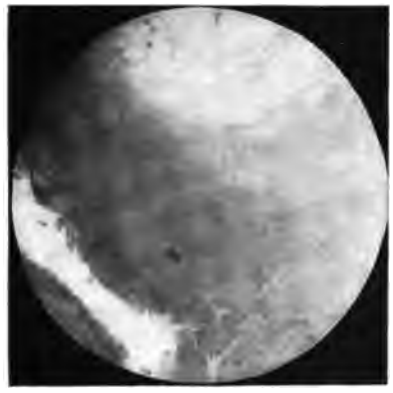
Blodgett[4] reports that his attention was called to a boy, 12 years of age, who was born of healthy parents and in whom no suspicion of malignant heredity could be found. Up to the age of 12 years this boy presented no indication of glandular or other disease. Soon after this time swelling was

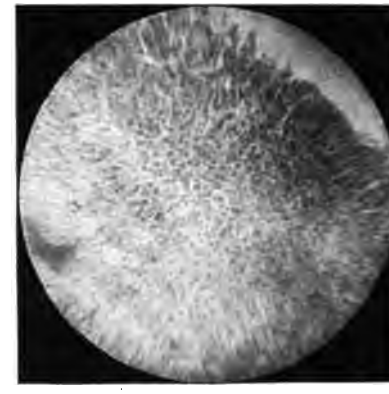
[1] Read before the Southern Surgical and Gynecological Association, Atlanta, December 16, 1913.

[2] Williams, W. R. Cancer of the male breast based on the records of 100 cases, with remarks. Lancet, Lond., 1889, ii, 261.

[3] Lunn, J. R.: Case of cancer of the breast in man aged 91 years. Tr. Pathol. Soc. Lond., 1897, viii, 247.

[4] Blodgett, A. M. Boston M. & S. J., 1897, cxxxvi, 611.





noticed in the left breast, beneath and attached to the nipple, which was slightly reddened and harder than its fellow of the opposite side. The growth on microscopic examination presented the typical structure of carcinoma, and had invaded all visible glandular tissue of the breast. The wound healed by first intention and there has been no indication of recurrence or metastasis since the operation was performed five years ago.

The case which the writer wishes to present is that of A. C., age 14 years, 8 months, operated on February 6, 1913. In August, six months before operation, the boy, while playing golf, was struck a violent blow on the right breast at about the nipple by a golf ball in flight, which left its impress and made him quite sore for several days. He soon got over the soreness, paid no further attention to it, but five months later, in January, while bathing, noticed a little lump under and very close to the right nipple. It was not painful, but recalling the blow he received, his family decided to have the tumor investigated. On examination the boy was found to be an exceedingly well developed specimen, 5 feet 2 inches, weighing 116 pounds, erect in figure and enjoying the best of health. The family history is negative throughout; heart and lungs negative. Urinalysis negative, and the blood count of no peculiar interest. A small, round, hard tumor, about the size of the smallest cherry stone, was found in the lower right quadrant about one-eighth of an inch from the nipple, freely movable under the skin and on the underlying fascia.

The nipple was the same as on the left side; there was no retraction nor dimpling. The skin over the tumor showed nothing unusual and the most careful investigation of the glands in the axilla and about the clavicle and the inguinal region gave no evidence of their enlargement. In the last week the growth had been handled and palpated considerably and consequently was a little tender.

Under general anæsthesia a semicircular incision was made under the breast, the flap dissected back, the tumor and surrounding fascia were removed down to the pectoral muscle, and the wound brought together without drainage, the patient leaving the hospital in three days. A report by Dr. S. B. Moon, pathologist to Grace Hospital, states that "the specimen, 1014, is adenofibroma with distinct scirrhous carcinoma in scattered areas of rather active cell proliferation."

The anatomical and pathological differences between the male and female breast are in degree rather than in kind:

Both develop normally until the beginning of the second decade when the female breast begins to take on its complex functions and duties, the male to be arrested in growth.

Occasionally there are embryological dislodgments of subepidermal nodules which may extend into the region of the male breast, histologically impossible to differentiate from carcinoma, yet they are not cancer. The bean-like submucous nodules found now and then in the appendix belong to this group. They are unquestionably of congenital origin. Aschoff calls them submucous nævi. In the report of Mayo's clinics by McCarty, these nodules are called carcinoma of the appendix and have been observed, according to McCarty, from a boy of nine to a man of eighty years of age.

The diagnosis must be made along identically the same lines as in the female. The same morbid rules obtain. It would appear that tumors of the male breast should be recognized earlier than in the female; small growths are more easily noticed, as they are not surrounded by so much breast tissue. In the later stages, pain, retraction, ulceration, and metastasis conform to the anatomic principles of the female. The prognosis and mortality then should be better for carcinoma of the male breast than in the female.

# EVENTRATION OF THE DIAPHRAGM[1]

## With the Report of a Typical Case with X-Ray Diagnosis

By IRVING F. STEIN, B. S., M. D., Chicago
Michael Reese Hospital

THE condition known as eventration of the diaphragm is not really a diaphragmatic hernia, but a diffuse relaxation of half of the diaphragm, simulating a hernia. Griffin (1) suggests "elevation of the diaphragm" as a better name. It is generally considered a congenital condition, the left half usually being involved. The diaphragm loses its muscular quality and becomes a fibrous membrane with atrophy and fatty deposit. The degree of eventration varies greatly, and may reach the level of the second rib.

The exact cause of the condition is unknown. Baetge (2) acknowledges that it is a developmental anomaly. Vogel (3) holds that it is due to congenital predisposition, with degenerative changes in the muscular fibers. Motzfeldt (4) has found atrophy of the phrenic nerve on that side, and offers three hypotheses: (1) Primary aplasia of the musculature, with secondary atrophy and degeneration of the phrenic nerve; (2) primary aplasia and atrophy of the phrenic nerve, with secondary muscle degeneration; (3) both together. Trauma has been offered as a cause in only one case — that reported by Reuss (5), in which a man 46 years old, who was always accustomed to hard work, sustained a fall, after which he suffered marked palpitation and cyanosis, with displacement of the heart to the right. The X-ray revealed the diaphragm on the left side at the level of the third rib.

This condition may exist for some time without symptoms, as evidenced by the fact that the majority of cases reported were adults. In all marked cases dyspnœa, cyanosis, and palpitation are present on the slightest exertion, due to the pressure of the abdominal organs on the heart and lungs; also difficulty is encountered in lying upon the healthy side. Pain is an inconstant symptom; constipation is usual, and dysphagia paradoxa and hæmatemesis are occasional. Upon examination the abdomen is often found retracted, with the chest flaring below, with an increase in size of the affected side. In children, there may be respiratory protrusion between the ribs. The heart usually is displaced to the right — markedly so in the cases recently reported. Over the affected side the chest is tympanitic, with gurgling sounds and absence of breath sounds.

The diagnosis is very difficult, even in the most extreme cases, without the aid of the X-ray. With the fluoroscope the paradoxical respiratory phenomenon may be demonstrated, and the röntgenogram usually portrays the remains of the diaphragm as a fine line above the visceral mass. With bismuth in the stomach or colon, the X-ray diagnosis is made certain. Griffin holds that the appearance of bismuth in the colon above the bow-like line of the chest is conclusive evidence of diaphragmatic elevation or hernia.

In the differential diagnosis it is most difficult to distinguish between eventration and a hernia through a large congenital defect. Other conditions to be considered are pneumothorax, especially when associated with dextrocardia, subphrenic abscess, pyopneumothorax, and œsophageal diverticulum. Cohn (6) reports one case which had been diagnosed cardiospasm by competent clinicians in which the X-ray revealed an eventration of the diaphragm. Motzfeldt's case, a woman 41 years old, had previously been reported by Höst in 1911 as a case of dextrocardia, and at autopsy the diaphragm on the left side was found at the level of the second interspace, although its insertion in the thorax was normal.

At post-mortem it may be found that any or all of the abdominal organs may be in the chest. The heart is usually displaced to the right and often enlarged, and the

[1] Read before the Chicago Medical Society, November 14, 1913.

Fig. 1. Röntgenogram taken on fourth day of life. Apparent absence of diaphragm on the left side with bowel shadows in the chest. Retraction of abdomen.

lungs compressed. Other congenital anomalies occasionally are found, as in the case reported below, in which the testicles were found undescended. Only one case of right-sided eventration was found in the literature (7).

The name eventratio diaphragmatica was given by Petit in 1790. The condition was noticed as early as 1783 by Pyl, and a typical case reported by Frariep in 1857, occurring in a 19-year-old girl. Petit first differentiated it from the usual diaphragmatic hernia. The latter is a surgical condition, while eventration of the diaphragm is not.

According to Vogel and Giffin, there are about twenty cases reported up to 1912. Motzfeldt, however, only recognizes those in which the diaphragm is described as a fibrous structure and not merely elevated. He collected eleven cases up to 1913, and reported one more. Subsequent to his article, I have been able to collect six cases reported as eventration of the diaphragm by Baetge (2), Haase (8), Reuss (5), and Kayser (9), in all of which (still living when reported) X-ray diagnosis was made. Whether Scheidemandel's (10) two cases are included in Motzfeldt's report I do not know, as his bibliography is not complete.

I wish to report another case of congenital eventration of the diaphragm in which the X-ray diagnosis was made a few days after birth.

Baby G. was born in the maternity department of the Michael Reese Hospital in the service of Dr. Ludwig Simon on June 14, 1913. The mother was a Russian, aged 33, a II-para, whose first child was healthy and normal. A Wassermann test made on the mother was negative. The child was born with a "caul" and with the cord wrapped once about the neck; otherwise labor and delivery were normal. At birth a marked asphyxia livida was present, and no effort at respiration was made until artificial measures (Byrd's method of resuscitation and warm tubbing) were employed for twenty minutes. Cyanosis did not then entirely disappear, and the pulse and respiration were very rapid. Examination at this time revealed a dextrocardia, scaphoid belly, and undescended testes. As soon as respiration was established the child was put into the stork-tub, external

Fig. 2. Röntgenogram taken three and six hours after ingestion of bismuth. Stomach and bowel in chest.

heat was applied, and breast milk dr. 1 given every two hours with a medicine dropper. The birth weight was 3310 gms.

June 16: Great difficulty was encountered in nursing, with marked cyanosis and convulsive movements when at the breast. The infant was taken from the breast and given mother's milk by bottle.

June 17: Respirations continued very rapid, and spells of very marked cyanosis occurred. Maximum temperature was 101°. Weight 3100 gms. Physical examination revealed the left chest tympanitic, the whole abdomen dull, and the edge of the liver not palpable. The belly was markedly retracted. The bow-line of the chest was flaring. Gurgling sounds were heard in the left chest, and breath sounds were heard only in the right chest posteriorly. The heart beat was rapid, but the tones were clear.

June 18: the fourth day of life: The general condition was improved; feeding retained, and there was no vomiting. A röntgenogram (Fig. 1) taken by Dr. Frances Turley revealed the heart in the right chest and liver on the right side. There was an apparent absence of the diaphragm on the left side, with the bowel shadows in the chest. The infant was placed on its left side with the head somewhat elevated, to relieve as much as possible the pressure on the thoracic viscera. The feedings were increased to breast milk 1 oz. every two hours.

Fig. 3. Röntgenogram taken immediately after ingestion of bismuth. Demonstrating stomach high in chest.

Fig. 4. Röntgenogram taken soon after death with bismuth in the bronchi. Only lower lobe of right lung admitted the bismuth emulsion. The gas distention of the stomach and bowels here beautifully portrays the extent of eventration.

June 19: The general condition was good. Cyanosis was less marked. Weight 3140 gms. An attempt to give a bismuth and starch enema for an X-ray picture of the colon failed.

June 21: Weight 3150 gms. Temp. 97.4°. Feedings were increased to 2 oz. every three hours. Bismuth subcarbonate was given in the early morning feedings, and a röntgenogram (Fig. 2) was taken three and six hours after ingestion. Another feeding was then given and a second picture (Fig. 3) immediately taken. As seen on the accompanying röntgenograms, the stomach and part of the small and large intestine were found high in the left chest, and the heart pushed to the right.

June 23: A spell of deep cyanosis was noted after attempt at nursing again. The protocol recorded that the cord was off and the navel was in good condition. Temperature 98.6°, respirations 120. Weight 3100 gms.

June 28: A crying spell with marked cyanosis was again noted. Temperature 101°, respirations 110. Weight 3135 gms.

July 1: The general condition was improved; the cyanosis was less marked, and the infant nursed at the breast with little difficulty. Weight 3215 gms. Temperature 98°, respirations 96.

July 9: The course for the past week has been

Fig. 5. Photograph showing the relations of the eventration in the thorax.

uneventful, but to-day a severe crying spell occurred, with very deep cyanosis, so that the child's condition looked desperate. Stimulation gave some relief. The mother was discharged from the hospital, and the infant transferred to the Sarah Morris Hospital. The weight was 3305 gms., only 5 gm. below the birth weight. Admitted to the Sarah Morris Hospital in the medical service of Dr. Ernest Lackner. Soon after admission another severe crying spell occurred, with marked cyanosis. Dysphagia was also noted. Temperature 96.6°, pulse 160, respirations 44. The cyanosis cleared somewhat, and breast milk oz. 3 was taken in the evening. The infant passed a fair night, but appeared very weak in the morning.

July 10; the twenty-sixth day of life: At 2 P.M. the child suddenly became very cyanotic and dyspnœic. All attempts at stimulation failed. The condition grew gradually worse in spite of all heroic measures and exitus occurred at 4.10 P.M.

An autopsy permit was obtained from the mother; before posting, however, a tracheotomy was performed, and a bismuth emulsion injected into the bronchi to determine the amount of functionating lung. The röntgenogram (Fig. 4) revealed what later was found to be the case, namely, that the lower lobe of the right lung was the only portion which contained air. This picture also gives the best view of the eventration.

The abdominal parietes were opened in the usual manner, and the anterior chest wall removed without disturbing the lower rib border, and a photograph taken (Fig. 5) before disturbing any of the relations. Examination revealed a typical eventration of the diaphragm with the stomach, the greater part of the small and large intestine, the spleen, the left lobe of the liver, the tail of the pancreas, and the upper pole of the left kidney in the chest. The heart was found greatly enlarged and pushed extremely to the right. The lungs were found above and to the right of the diaphragm, all compressed except the lower lobe of the right lung. The diaphragm on the left side was found to be a fibrous dome, thin and gray in appearance, extending to the level of the second interspace, in which no muscle fibers were seen. The remaining abnormality was that of undescended testes, which were found in the abdomen. The viscera were removed *in toto* and preserved in Kaiserling.

## BIBLIOGRAPHY


1. Giffin, H. Z. Ann. Surg., Phila., 1912, lv, 388.
2. Baetge, P. Deutsches Arch. f. klin. Med., 1913, cx, 49.
3. Vogel, K. M. Am. J. Med. Sc., 1913, cxlv, 206.
4. Motzfeldt, K. Deutsche med. Wchnschr., 1913, xxxix, 312.
5. Reuss. Ibid., 743.
6. Cohn, M. Arch. f. Verdauungskr., Berl., xvii, 198.
7. Eppinger. Allg. u. specielle Path. des Zwerchfells, 1911.
8. Haase, H. Wien. klin. Wchnschr., 1913, xxvi, 193.
9. Kayser, K. Fortschr. a. d. Geb. d. Röntgenstrahl., 1913, xx, 240.
10. Scheidemandel, E. München. med. Wchnschr., 1912, lix 2168.

# COMPLICATIONS FOLLOWING SURGICAL OPERATIONS

## A Report of the Complications in a Series of 6,825 Surgical Operations Performed in the Mayo Clinic in the Year 1913

By E. H. Beckman, M. D., Rochester, Minnesota

THE keeping of an accurate account from day to day of all the complications that occur following surgical operations is found to be an exceedingly valuable procedure. It allows one to sum up from month to month and year to year his failures and compare them with those of previous years. If this is not done, the small failures in surgical work are soon forgotten and the surgeon is inclined to feel that his results on the whole are better than they actually show when appearing in cold figures. It is comparable to a business firm balancing its books at the end of a period of business and is the only true way of acquiring an accurate knowledge of the results in surgical work. If there is not a marked improvement in a diminishing number of complications, one must conclude that the cases have been exceptionally unfavorable or that his technique is not improving. As was stated in a previous report, we find that this procedure has revealed many errors in technique which it has been possible for us to overcome.

In reporting the complications that occurred in the Mayo Clinic during the year 1912, it was stated that bacteriologic cultures would be made in the future from all wounds that did not heal primarily. The greater part, but not all, were subjected to bacteriologic investigation up to that time. In explanation, it should be stated that all wounds were considered as possibly infected in which there was an escape of fluid at any time during the patient's residence in the hospital. In order to secure perfect convalescence, it is believed that if the technique at the time of operation is as near perfect as our present knowledge of surgical methods allows, all wounds which are not drained should be dry at the time of leaving the operating room and should remain so until healing has occurred.

It is interesting in this connection to note that under this plan there occurred an escape of fluid from the wounds in thirty-five patients, cultures from which developed no growth. We, therefore, consider that these wounds were not infected in the ordinary sense of the word, but that irritation or a slight accumulation of blood placed so much work upon the tissues in the neighborhood of the wound that this extra fluid could not be absorbed readily and, though sterile, was finally discharged from the wound.

In last year's report, the statement was made that it appears in this clinic that most infections come from the tissues of the patients rather than from some outside source, such as suture material, dressings or instruments. In examining the bacteriologic report for 1913, this opinion seems to be verified to a marked degree since almost every organism identified is an organism which is commonly present in the body fluids or tissues and that these organisms are of the type that are readily destroyed by the methods of sterilization in common use in surgical clinics. Since we know that it is impossible to kill bacteria in the tissues of the body without destroying the vitality of these structures, and that the accessories used in the operating room, such as gloves, instruments, suture material and dressings, can readily be sterilized, it seems more reasonable to assume that the infection comes from the patient rather than that it is introduced into the patient from some outside source. We realize, however, that this cannot always be proved, but repeated bacteriologic examinations of dressings, suture material, water, etc., used in our clinic, have failed to reveal any living organisms.

The report this year includes 6,825 cases, comprising the in-patients of St. Mary's Hospital. These are the patients who had a sufficiently serious type of operation to require them to remain in the hospital during their convalescence. It does not include the

out-patients having minor operations who were allowed to leave the hospital soon after their operations.

### INFECTIONS

The infections for the year 1913 were 117, or a percentage of .017 for the 6,825 cases. The various groups of operations in which infections occurred are as follows:

TABLE 1

| | No. of Operations | No. of Infections |
|---|---|---|
| Appendectomy | 1,085 | 31 |
| Nephrectomy | 94 | 7 |
| Posterior gastro-enterostomy | 299 | 18 |
| Intestinal obstruction | 19 | 1 |
| Inguinal hernia | 308 | 17 |
| Ligation superior thyroid | 410 | 4 |
| Thyroidectomy | 1,137 | 7 |
| Subtotal abdominal hysterectomy | 230 | 5 |
| Freeing adhesions | ... | 1 |
| Exploration | 92 | 2 |
| Total abdominal hysterectomy | 79 | 5 |
| Internal alexander and appendectomy | 117 | 1 |
| Cholecystectomy | 524 | 2 |
| Bullet knee | 1 | 1 |
| Excision abdominal scar | 1 | 1 |
| Popliteal aneurism | 1 | 1 |
| Hernia and external alexander | 44 | 1 |
| Ventral hernia | 76 | 2 |
| Pyloroplasty and appendectomy | 13 | 1 |
| Resection stomach | 78 | 2 |
| Femoral hernia | 29 | 1 |
| Tuberculous glands neck | 60 | 2 |
| Submaxillary glands | 47 | 1 |
| Block dissection neck | 7 | 2 |
| Tubes and ovaries | 117 | 1 |
| Total | | 117 |

Table 2 shows the number of infections occurring each month with the type of bacteria present. It is shown that more infections were present in the winter months. We believe that this is the usual rule since the skin of the average patient is not in as good condition during these months as in the other months of the year. We have always felt that an active, healthy skin was capable of taking care of a considerable amount of infection, while one that was sluggish and irritated was in a condition to favor infection.

TABLE 2

INFECTIONS OCCURRING EACH MONTH

| | No growth. | B. coli. | Staph. albus. | Staph. aureus. | Staph. citreus. | Pneumococcus. | Diplococcus. | Streptococcus. | Unidentified B. | B. Subtilis. | Micro. Catarrhalis. | Not reported. | No growth. | Pure. | Mixed. | Total. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| January | 3 | 6 | 7 | 3 | 5 | 1 | 2 | 4 | 1 | 1 | .. | 5 | 3 | 14 | 7 | 26 |
| February | 1 | 2 | 4 | 6 | .. | 1 | 1 | 1 | .. | .. | .. | .. | 1 | 11 | 2 | 13 |
| March | 7 | 3 | 4 | .. | 1 | 1 | 3 | .. | .. | .. | .. | .. | 7 | 5 | 3 | 8 |
| April | 8 | 2 | .. | 2 | .. | .. | 1 | 1 | .. | .. | 1 | .. | 8 | 1 | 3 | 4 |
| May | 2 | 1 | 1 | 5 | .. | .. | 1 | .. | .. | .. | .. | .. | 2 | 6 | 1 | 7 |
| June | 3 | 2 | 3 | 3 | .. | .. | .. | .. | .. | 1 | .. | .. | 3 | 7 | 1 | 8 |
| July | 5 | 2 | .. | 1 | .. | .. | .. | .. | .. | .. | .. | .. | 5 | 5 | .. | 3 |
| Aug. and Sept. | .. | 6 | 7 | 3 | 2 | 2 | 1 | 2 | .. | .. | 2 | .. | .. | 9 | 7 | 16 |
| October | .. | 3 | 3 | 4 | .. | .. | .. | 2 | .. | .. | 1 | .. | .. | 4 | 4 | 8 |
| November | .. | 4 | 1 | 2 | 2 | 1 | .. | .. | .. | .. | .. | .. | 10 | .. | .. | 10 |
| December | 6 | 9 | 5 | 3 | 1 | 3 | 1 | 2 | .. | .. | 2 | .. | 6 | 7 | 7 | 14 |
| Total | 35 | 40 | 35 | 31 | 12 | 9 | 10 | 12 | 1 | 2 | 6 | 5 | 35 | 77 | 35 | 117 |

TABLE 3

CASES HAVING A SINGLE ORGANISM

*B. Coli* —
- Appendectomy 12
- Nephrectomy 2
- P. Gast. and App 2
- Intest. Obstr 1
- P. Gastro-enter 2
- Total 19

*Staph. albus.*—
- Rt. Ing. Hernia 2
- Gastro and App 1
- Lt. Ing. Hernia 1
- Appendectomy 4
- Lig. Sup. Thy 2
- App. & Rt. Ing. Hern 1
- Nephrectomy 2
- Thyroidectomy 1
- Sub. Abd. Hyst 1
- Freeing adhesions 1
- Dbl. Ing. Hernia 1
- Exploration 1
- Total 18

*Staph. pureus.*—
- Rt. Ing. Hernia 3
- Lt. Ing. Hernia 1
- Appendectomy 4
- P. Gastro-ent 4
- Thyroidectomy 2
- P. Gast. & App 2
- Total Abd. Hyst 2
- Exploration 1
- Int. Alex. & App 1
- Cholecystect. & Appendectomy 1
- Total 21

*Staph. citreus.*—
- Bullet knee 1
- Appendect 1
- Rt. Ing. Hern 1
- Gast. & App 1
- Gastro-enter 1
- Exc. Abd. scar 1
- Pop. Aneurism 1
- Total 7

*Pneumococcus* —
- Append 1
- Hernia and Ext. Alex 1
- Total 2

*Streptococcus* —
- Vent. Hernia 1
- Rt. Ing. Hern 1
- Thyroidect 1
- Total 3

*B. Subtil.*
- Append 1
- Nephrect. & Append 1
- Total 2

*Micro. Catar.*
- Append 1
- Thyroidect 1
- Ing. Hernia 1
- Total 3

Table 4 shows the cases in which the cultures from the wounds revealed more than one organism or a mixed culture.

### PULMONARY COMPLICATIONS

The total number of pulmonary complications was 87, or a percentage of .012 for the entire series. None of these were fatal. The deaths for the year will be reported elsewhere. Ether was used exclusively in the clinic as a general anæsthetic, novocaine as a local anæsthetic. The pul-

TABLE 4

CASES HAVING MORE THAN ONE ORGANISM

| | Bacillus Coli. | Staph. Albus. | Staph. Citreus. | Staph. Aureus. | Pneumococcus. | Streptococcus. | B. Subtilis. | Unidentified B. | Diplococcus. | Micro. Catarrhalis. |
|---|---|---|---|---|---|---|---|---|---|---|
| Left hernia | 1 | | 1 | | | | | | | |
| Total abdominal hysterectomy | | | 1 | | 1 | | | | | |
| Double inguinal hernia | | 2 | | | | 2 | | | | |
| Double inguinal hernia | 1 | | | 1 | | | | | | |
| Ventral hernia | | 1 | | | | 1 | | | | |
| Resection stomach | | 1 | | | | 1 | | | | |
| Gastro-enterostomy and Append | 1 | 1 | | | | 1 | | 1 | | |
| Total abdominal hysterectomy | 1 | | | | 1 | | | | | |
| Gastro-enterostomy and append | 1 | | | | | | | | 1 | |
| Appendectomy | 1 | 1 | | | | | | | | |
| Femoral hernia | 1 | 1 | | | | | | | | |
| Appendectomy | | | | 1 | | | 1 | | | |
| Tuberculous glands of neck | | 1 | | 1 | 1 | | | | | |
| Abdominal hysterectomy | | 1 | | | | | | | | 1 |
| Submaxillary glands | | | | 1 | | 1 | | | | |
| Appendectomy | 1 | | | | | | | | | 1 |
| Abdominal hysterectomy | | | | 1 | | | | | 1 | |
| Posterior gastro-enterostomy | | | | 1 | | 1 | | | | |
| Tuberculous glands of neck | | | | 1 | | | | | 1 | |
| Abdom. hysterect. and appendect | | 1 | | 1 | | | | | | |
| Hyster. ovary and tube | 1 | | | | 1 | 1 | | | | |
| Block neck | | 1 | 1 | 1 | | | | | 1 | |
| Appendectomy | | | | | | | | | | |
| Appendectomy | 1 | | | 1 | | | | | | |
| Tubes and ovary | 1 | 1 | | | | 1 | | | | |
| Nephrectomy | 1 | 1 | | | | | | | | |
| Appendectomy | 1 | 1 | | | | | | | | |
| Hernia | 1 | | | 1 | | | | | | |
| Resection stomach | 1 | | | | 1 | | | | 1 | 1 |
| Nephrectomy | 1 | 1 | | | | 1 | | | | |
| Gastro-enterostomy | | 1 | | | | 1 | | | | |
| Appendectomy | | 1 | | | | | | | | 1 |
| Anterior gastro-enterostomy | | | | | 1 | | | | | 1 |
| Total abdom. hysterectomy | 1 | 1 | | | | 1 | | | | |
| Thyroidectomy | 1 | 1 | | | | 1 | | | | |
| Totals | 18 | 19 | 3 | 11 | 6 | 13 | 1 | 1 | 5 | 5 |

monary complications have been classified in five groups.

*Group 1. Acute post-operative congestion of the lungs.* Into this group are placed those patients who disclosed acute congestion or an excess of secretion in the air passages as soon as they were returned from the operating room or within twenty-four hours thereafter. Many of these cases were patients that were on the verge of an acute cold but had not revealed sufficient symptoms prior to the operation to warn the operator against proceeding. Certain others were patients that had vomited and sucked into the air passages infectious material from the mouth and pharynx. Others were probably those that had congestion due to prolonged cooling of the air passages from a long anæsthetic. We know that an excess of secretion in the air passages is due to irritation so that we assume the excess in these cases must be due to some form of irritation.

TABLE 5

ACUTE POST-OPERATIVE CONGESTION OF LUNGS

| | |
|---|---|
| Anterior gastro-enterostomy and appendectomy | 1 |
| Excision duodenal ulcer and cholecystectomy | 1 |
| Appendectomy | 2 |
| Resection of stomach | 1 |
| Inguinal hernia | 3 |
| Appendectomy and extra-uterine pregnancy | 1 |
| Cholecystect., appendectomy and gastro-enterostomy | 1 |
| Gastro-enterostomy and appendectomy | 1 |
| Posterior gastro-enterostomy | 3 |
| Splenectomy | 1 |
| Cholecyst-jejunostomy | 1 |
| Appendectomy and iliac kink | 1 |
| Exploration of abdomen | 1 |
| Cholecystectomy and choledochotomy | 1 |
| Colostomy and resection of colon and urin. bladder | 1 |
| Cholecystostomy and appendectomy | 1 |
| Total | 21 |

*Group 2. Pleurisy.* Patients having a pain in the chest with or without a slight rise in temperature and a slight cough without expectoration are classified in this group. There is often no cough or increase in temperature but the presence of pain and a pleuritic rub on auscultation. The symptoms last from a few days to a week, rarely longer. I believe that patients operated on for pathologic conditions in the upper abdomen often have pleurisy as the result of the post-operative inflammatory reaction extending to the diaphragm and pleura.

TABLE 6

PLEURISY

| | |
|---|---|
| Gastro-enterostomy | 3 |
| Supravaginal hysterectomy | 1 |
| Cholecystectomy | 3 |
| Resection of stomach | 1 |
| Laparotomy for pelvic inflammation and appendectomy | 1 |
| Appendectomy and Baldy-Webster | 1 |
| Currettage and Baldy-Webster | 1 |
| Appendectomy and ing. herniotomy | 1 |
| Nephrectomy | 1 |
| Vaginal hysterect. and perineorr | 1 |
| Thyroidectomy | 1 |
| Cholecystostomy and appendectomy | 1 |
| Litt. colostomy | 1 |
| Choledochotomy | 1 |
| Total | 18 |

*Group 3. Bronchitis.* In this group are the patients who have an excessive secretion in the air passages. Many of them have only a slight rise in temperature for a few days and

expectorate an excessive amount of mucous or mucopurulent material. Others have a temperature of 102° to 103° F. with increased respiration but the symptoms subside quickly and the temperature drops to normal in from 48 to 72 hours, although the cough and expectoration may continue for several days longer. The physical examination discloses no areas of consolidation in the lungs. It is often difficult in these cases to differentiate between a congestion of the lungs, or, more properly, a congestion of the mucous membrane of the air passages and a true bronchitis.

TABLE 7

ACUTE BRONCHITIS

| | |
|---|---|
| Appendectomy | 3 |
| Post-operative ventral hernia | 1 |
| Nephrect., ureterect., cholecystost., and appendectomy | 1 |
| App. and post. gastro-enterostomy | 2 |
| Baldy-Webster and currettage | 1 |
| Abdominal hysterectomy | 1 |
| Cholecystectomy | 1 |
| Exploration cancer of stomach | 1 |
| Choledochotomy and cholecystectomy | 1 |
| Excision duod. ulcer and pyloroplasty | 1 |
| Pyloroplasty, Finney | 1 |
| Nephrectomy | 1 |
| Lig. right superior thyroid arteries | 1 |
| Closure fæcal fistula and app | 1 |
| Closure fæcal fistula | 1 |
| Excision duod. ulcer and gastro-enterostomy | 1 |
| Gastro-enterostomy | 2 |
| Total | 21 |

*Group 4. Bronchopneumonia.* These patients have the same symptoms as those of the preceding group, usually to a more marked degree. Inflammation here has apparently extended at certain points from the air passages into the tissues of the lung and the physical examination reveals areas of consolidation or congestion. Convalescence is slower than in the previous group.

TABLE 8

BRONCHOPNEUMONIA

| | |
|---|---|
| Appendectomy | 2 |
| Resection pylorus | 1 |
| Gastro-enterostomy, herniotomy and appendectomy | 1 |
| Posterior gastro-enterostomy | 2 |
| Cholecystostomy and appendectomy | 1 |
| App. (acute abscess) | 1 |
| Thyroidectomy | 1 |
| Cholecystostomy | 1 |
| Enuc. eye and post-operative ventral hernia | 1 |
| Pyloroplasty | 1 |
| Total | 12 |

*Group 5. Lobar pneumonia.* In this group are those patients who have a definite consolidation of the lung with a temperature of 102° or more and the classical symptoms of pneumonia. The temperature is more likely to subside by lysis than by crisis. We still believe that septic emboli cause many of these conditions. They rarely occur earlier than the third or fourth day following operation.

TABLE 9

LOBAR PNEUMONIA

| | |
|---|---|
| Cholecystenterostomy | 1 |
| Pyloroplasty | 2 |
| Appendectomy | 1 |
| Abdominal exploration | 1 |
| Cholecystectomy and choledochotomy | 1 |
| Cholecystectomy | 1 |
| Thyroidectomy | 2 |
| Cholecystectomy and appendectomy | 2 |
| Gastro-enterostomy | 2 |
| Total abdominal hysterectomy | 1 |
| Anterior gastro-enterostomy | 1 |
| Total | 15 |

THROMBOPHLEBITIS

The total number of cases having a thrombophlebitis was 14. Table 10 shows the number upon the right and left sides with the type of operation. We have not been able to determine any method of lessening this annoying complication. Most of our patients upon whom abdominal operations have been performed are out of bed by the eighth to the twelfth day, except those who have had simple appendectomies; these are allowed to get up on the sixth or seventh day following operation. There is a higher proportion of thrombophlebitis on the right side than has occurred in previous years. In our experi-

TABLE 10

THROMBOPHLEBITIS

| | Right. | Left. |
|---|---|---|
| Nephrectomy | .. | 2 |
| Exc. duod. ulcer, cholecystect. and appendectomy | .. | 1 |
| Abdominal hysterectomy | 2 | 1 |
| Cholecystost. and ant. Hartman | 1 | .. |
| Abdominal myomectomy | 1 | .. |
| Vaginal hysterectomy | .. | 1 |
| Abdominal hysterectomy | .. | 1 |
| Cholecystostomy and appendectomy | 1 | .. |
| Drainage large pelvic abscess | .. | 1 |
| Gastro-enterostomy | 1 | .. |
| Removal ovarian cyst with twisted pedicle | .. | 1 |
| Totals | 6 | 8 |

ence, patients with infection are not more prone to have thrombophlebitis than the so-called clean cases.

*Acute Dilatation of the Stomach.* It is to be seen that during the year this complication occurred in but three instances. We believe this distressing complication has been avoided by frequent and early lavage. A patient who continues to vomit after the first twenty-four hours is placed upon routine lavage. The stomach is washed once or twice a day, or oftener if it seems advisable, until vomiting ceases.

The other complications listed herein are such as are apt to occur in any large surgical clinic, but are not in sufficient numbers to warrant conclusions being drawn.

ACUTE DILATATION OF STOMACH

| | |
|---|---|
| Cholecystectomy and appendectomy | 2 |
| Cholecystectomy and choledochotomy | 1 |
| Total | 3 |

EMPYEMA CHEST

| | |
|---|---|
| Transplantation right ureter for extrophy bladder | 1 |

OBSTRUCTION OF BOWELS

| | |
|---|---|
| Resection of stomach | 1 |
| Resection of urinary bladder | 1 |
| Nephrectomy | 1 |
| Total | 3 |

SURGICAL RASH

| | |
|---|---|
| Suprapubic prostatectomy | 1 |
| Appendectomy and currettage | 1 |
| Ligation right superior thyroid artery | 1 |
| Cholecystostomy and anterior Hartman | 1 |
| Total | 4 |

CYSTITIS

| | |
|---|---|
| Resection of rectum | 2 |
| Vaginal hysterectomy | 1 |
| Appendectomy | 1 |
| Total | 4 |

POST-OPERATIVE MISCARRIAGE

| | |
|---|---|
| Appendectomy | 1 |

NEURITIS

| | |
|---|---|
| Appendectomy (sciatic) | 1 |
| Subtotal abdominal hysterectomy (arm) | 1 |
| Total | 2 |

ARTHRITIS

| | |
|---|---|
| Appendectomy | 1 |
| Posterior gastro-enterostomy | 1 |
| Total | 2 |

TONSILLITIS

| | |
|---|---|
| Ligation superior thyroid vessels | 2 |
| Appendectomy | 1 |
| Total abdominal hysterectomy | 1 |
| Baldy-Webster operation | 1 |
| Removal lithopœdian | 1 |
| Total | 6 |

DILATATION OF HEART, ACUTE

| | |
|---|---|
| Thyroidectomy | 2 |
| Ligation one superior thyroid artery | 1 |
| Total | 3 |

DELIRIUM TREMENS

| | |
|---|---|
| Inguinal hernia | 1 |

SLIGHT BLEEDING FROM WOUND IN CASES WITH MARKED JAUNDICE

| | |
|---|---|
| Cholecystectomy and choledochotomy | 2 |
| Secondary choledochotomy | 1 |
| Total | 3 |

URINARY FISTULA

| | |
|---|---|
| Total abdominal hysterectomy and removal of portion of bladder | 1 |
| Supravaginal hysterectomy | 1 |
| Total | 2 |

MEASLES

| | |
|---|---|
| Transplantation of one ureter | 1 |

PAROTITIS

| | |
|---|---|
| Abdominal hysterectomy | 1 |
| Posterior gastro-enterostomy | 1 |
| Ovarian cyst-dermoid with twisted pedicle | 1 |
| Total | 3 |

SCARLATINA

| | |
|---|---|
| Choledochotomy and cholecystectomy | 1 |

PANCREATIC FISTULA

| | |
|---|---|
| Choledochotomy and cholecystectomy | 1 |

FISTULA FROM GASTRO-ENTEROSTOMY

| | |
|---|---|
| Gastro-enterostomy and cholecystectomy | 1 |

ERYSIPELAS (FACIAL)

| | |
|---|---|
| Cauterization of cancer of cervix | 1 |

There were no fatalities included in the cases reported above.

# HYSTEROMYOMECTOMY, ITS EVOLUTION AND PERFECTION[1]

By LEWIS S. McMURTRY, M. D., Louisville, Kentucky

WE are living in an age of marvelous scientific achievement. The advance of the science and art of surgery has been so rapid, and new methods are so quickly evolved, that we need at times to trace the steps by which we have attained existing results. Not only is such a retrospect interesting, but in many ways instructive and profitable. It is not at all uncommon in studying the history of an operation or other therapeutic resource to find the method adopted finally had been previously used and discarded. Thus in the light of experience and improved knowledge it is often necessary to retrace our steps and restore old methods to the place from which they had been stricken. A notable illustration of this fact will be found in the narrative I herewith present of the various steps by which the present surgical treatment of uterine fibroid tumors has been established. It will be noted that in the first operations for removing these tumors by hysterectomy the uterine cervix was ligatured and dropped in the pelvis. After many years, during which the pedicle was fixed in the abdominal incision by the aid of the serrenœud, clamp or elastic ligature, the original method, with certain modifications, was restored and remains in universal use. The one persistent and universal characteristic of all perfected surgical procedures is simplicity. As knowledge advances and precision increases, operative methods become more direct and uncomplicated.

The purpose of this paper will be best subserved by omitting a detailed account of the early surgery of fibroid tumors of the uterus. In most instances the earliest operations were stumbled upon when the operator expected to do ovariotomy. As in ovariotomy, American surgeons were prominent in the pioneer work of this operation, and have contributed the most essential features of the operation now so successfully practiced in this country. The names of Charles Clay and Spencer Wells in England; Burnham, Kimball and Washington Atlee in America; Koeberle, Schroeder and Hegar in Germany, and Pean in France, are associated with the foundation and early history of the treatment of uterine fibromata by abdominal section and excision of the tumor. So great was the mortality following the operation in the hands of its founders that it was not adopted by surgeons generally. With the exception of a few bold spirits who struggled on despite all discouragements and in the face of repeated disaster, the operation was regarded with disfavor. This was the status of the operation from its foundation in 1843 up to the advent of the Listerian era in surgery. The mortality of the operation during this period in the hands of skilled operators was from 30 to 40 per cent.

In 1885 Thomas Keith, of Edinburgh, issued a report of forty cases of fibroid tumors of the uterus treated by abdominal hysterectomy. This series embraced all the operations he had done up to that time, and extending over a period of twelve years. In all these cases the pedicle was treated extraperitoneally with the serrenœud or clamp. In all of these cases some antiseptic measures as taught by Lister were applied. In some the carbolic spray was used, and later abandoned. In the series of forty cases there were four deaths. As the antiseptic measures were crude and imperfect, the convalescence was in most cases protracted and febrile, but the results were so much superior to any previously recorded that the operation was established in professional confidence. Dr. Keith was at this time at the height of his physical and mental powers, and exercised a powerful influence upon surgical opinion throughout the surgical world. His monograph publishing in detail his work in this field is a model of its class. Indeed, it should hold a place among the classics of gynecological literature. If I may impose upon your indulgence for a momentary digression, I

[1] Read before the Chicago Gynecological Society, November 15, 1913. (See discussion, p. 649.)

would quote one sentence from the introductory chapter of this book. Commenting upon the beneficent offices of the antiseptic system of Lister, he writes these words: "It is, unfortunately, a melancholy story that ever since surgery began, the most of the mischief was done by the surgeon himself. It was the willing and tender, though *unclean*, hand that carried the poison into the wounds."

Lawson Tait, of Birmingham, the founder of modern gynecology and the greatest surgical genius of his time, was born and educated in Edinburgh and was a frequent visitor there after taking up his residence in England. He witnessed Keith's operation, and with that skill which made him famous applied it in practice. He adopted the serrenœud and treated the pedicle as Keith did, and even surpassed him in the technique of the operation. He did more than any other operator to establish the operation in universal favor throughout the world. There was no marked improvement by these great Scotch surgeons in the operative technique of Koeberle, Atlee, and Pean previously described. The marvelous improvement in results was due to the application of Listerian principles and the elimination of sepsis. The same may be said of the work of Bantock and Thornton in London, who worked along these lines.

Up to this time the belief was firmly fixed in the surgical mind that the cervical pedicle offered peculiar difficulties. If ligatured and dropped, the tissues would retract and slip from the grasp of the ligature and fatal hæmorrhage would follow. Sloughing of the strangulated tissue and fatal peritonitis were attributed to the intraperitoneal stump. The serrenœud was invented and used to avert these dangers. After tying off the broad ligaments the pedicle was drawn up into the lower angle of the wound; pins were applied to retain the pedicle *in situ;* the serrenœud was placed and tightened and the tumor cut away. Some operators replaced the serrenœud with the elastic ligature, and another refinement consisted in stripping the peritoneum from the cervical pedicle and stitching it to the adjacent parietal peritoneum so as to assure an extraperitoneal fixation of the pedicle. But the sloughing of the stump, the protracted convalescence, the discomfort to the patient, and the frequency of post-operative hernia impelled surgeons to seek a method more surgical and refined. Many ingenious efforts were made to replace the extraperitoneal nœud with an intraperitoneal ligatured or sutured stump, but without avail until the procedure now to be mentioned was devised.

In 1889 Lewis A. Stimson, of New York, proposed and practiced the ligation of the four trunk arteries (the uterine and ovarian on each side) in their course. In this way mass ligatures were done away with, and the danger of hæmorrhage and sepsis enormously reduced. Following upon this J. Riddle Goffe, in 1890, made his valuable contribution to the technique of the operation, which consists in providing peritoneal flaps for the cervical pedicle so that it becomes extraperitoneal and at the same time intrapelvic. Other and important details were worked out by Dudley, Pryor, F. H. Martin, and Kelly, and in 1891, B. F. Baer, of Philadelphia, published the systematic application of these various modifications in the method of supravaginal hysteromyomectomy, with extraperitoneal dropped pedicle as now generally practiced. Various modifications have since been added to perfect details of technique. The operation was markedly advanced by the use of catgut throughout for ligatures and sutures, the adoption of the Trendelenburg position, and the use of rubber gloves. Without enumerating the numerous suggestions of various surgeons, such as cauterization and excision of the cervical mucosa in treating the pedicle, the operation as now done in America is as follows:

The patient is placed in the Trendelenburg position and the abdomen opened with a free incision. After exploring the tumor with the hand and separating adhesions, the tumor and uterus are delivered through the abdominal incision. The intestines are carefully packed off with gauze so as to expose the contents of the true pelvis. A heavy volsellum forceps may be necessary to secure delivery of the tumor. The broad ligaments are secured on each side with clamps, and

divided between two clamps down to the base of the tumor and near the uterine cervix. The peritoneum on the anterior face of the uterus and broad ligaments is divided, the incision extending from one round ligament to the other and the vesical peritoneum is then freed and pushed downward with a piece of gauze. Traction is then made upon the tumor, which is rolled over to one side and the uterine vessels are exposed by separating the broad ligament with a gauze sponge. The uterine artery is then secured low down on the cervix with a clamp. A ligature may be applied at this stage of the operation, or the vessels secured by the clamp until the tumor is removed. The same procedure is carried out on the opposite side. The cervix is divided below the level of the internal os, an effort being made to remove a wedge-shaped piece from the cervix, and a small posterior flap is formed by stripping up the posterior cervical peritoneum while the section of the cervix is being made. The cervix is closed with a few interrupted catgut sutures, thus making hæmostasis complete. The four trunk arteries, now securely clamped. are carefully ligatured with No. 2 catgut; the anterior and posterior flaps of peritoneum are now sutured across the floor of the pelvis and over the cervical stump with a continuous catgut suture. When there is a tendency for the cervix to prolapse, the upper border of each broad ligament together with the round ligament may be sutured to the cervical stump before covering the stump with the peritoneal flap. The peritoneal flap should be drawn snugly over the cervix so as to prevent the formation of a dead space. The pelvis is now cleansed of clots with the aid of gauze wrung out of normal salt solution, the gauze pack gently removed, the patient placed in the horizontal position and the abdomen closed. In removing the tumor, and while dealing with the broad ligament, for obvious reasons one or both ovaries should be preserved whenever it is practicable to do so. Even a part of one ovary should be retained if possible.

The advantage of this operation over all other operative procedures which have been devised for the removal of fibroid tumors by abdominal hysterectomy is its wide applicability. However irregular the growth may be, and however varied its morphology, the experienced operator will usually be able to work a path to the cervix and obtain a good pedicle. It is rare that the cervix is so involved in multiple tumors that it cannot be isolated and retained in place. This procedure has a distinct advantage over other methods in the reasonable time limit with which it can be carried out. By retaining the cervix the normal floor of the pelvis and relation of the vagina to adjacent structures is anatomically preserved. The objection has been made that the retained cervix may become the seat of malignant disease, but this is very rare. In a very entensive experience with the operation, covering several hundreds of cases some of which have been under observation for years, I have known only one instance in which cancer developed in the cervical pedicle after hysteromyomectomy. In my entire experience I have never injured the ureters in this operation. The mortality of this operation in average cases and at the hands of skilled surgeons is about 2 per cent. I submit that by no other procedure can these results be equaled.

In 1888 M. A. D. Jones performed the first total hysterectomy for uterine fibroma in America. Bardenheuer had preceded this operation, but his work was not known in this country at that time. This operation, known as panhysterectomy, has been modified in various ways. It has been practiced as an additional step in the operation I have described, the tumor being cut away from the cervix, the cervix seized with volsellum forceps and then removed in its entirety. Another method is that known as the combined operation, and consists of a preliminary vaginal dissection of the cervix, followed by abdominal section and hysterectomy as already described. A third method and one favored by many surgeons is that of Doyen. In this operation the uterus and the tumor are brought forward and over the pubes, the posterior vaginal fornix is opened through the pouch of Douglas, the cervix is drawn through the posterior vaginal walls laterally

and in front. The broad ligaments and uterine vessels are clamped, if necessary, and by continuous incision the fibroid is stripped out of its attachments. After the uterus has been removed, the adnexa are dealt with as indicated, the vagina closed with sutures and the peritoneum united over it.

Time will not permit bare mention of the numerous procedures devised by surgeons of all countries during recent years to cope with atypical cases and special complications in operating for uterine fibromata. These tumors grow in the most fantastic way, and dispose themselves with relation to the peritoneum and adjacent structures in great variety. Among the numerous methods devised for atypical cases one of the most valuable is that of bisection as practiced by Kelly.

With these various procedures the modern surgeon is prepared to cope successfully with every form and variety of uterine fibroid tumors, and will be prompted by sound surgical judgment to elect the procedure best suited to the case in hand. As a result the operation has become in the hands of trained gynecological surgeons the most successful major operation known to surgery. It is not the purpose of this paper to offer any new theory in pathology or to present any unique operative procedure, but rather, by going over familiar paths which those here assembled have trod, to confirm for the present at least the faith that has been tried and proven.

---

# "EFFICIENCY ENGINEERING" IN PELVIC SURGERY: ONE AND TWO-SUTURE OPERATIONS[1]

By ROBERT L. DICKINSON, M. D., F. A. C. S., Brooklyn, New York

THIS paper is a plea for systematic study of our efficiency. If other handicraftsmen are employing experts to teach them how to eliminate waste motions and how to standardize technique, it behooves us to further such investigations in operating room, in ward, and in office. For beyond any other craft the surgeon's work demands the new "scientific management." It is not only that on occasions time is a matter of life and death; it is not only that speed is a matter of lessened shock and quicker recovery; it is mainly that habits of hand work controlled in the ways of the best motions by the automatic lower centers bring about freedom of the higher brain for those weighty decisions, that concentration on the rest of the problem, and that watchfulness of the patient which are called for in nearly every operation. No item is too small to think of, no training too laborious. All the way from printed directions for office patients up to dissection in the most radical cancer operations there is hardly a detail unworthy of consideration. The present question is how to attack the problem. It must first be defined, its parts allotted, the tentative results published for test by a number of operators, and a clearing house devised for combining conclusions. Meanwhile let us glance at some aspects of the matter.

*Hospital Standardization.* Toward the standardization of medical schools, here and abroad, a long first step was taken by disinterested outside study.[2] Whether we agree or disagree with the premises on which the estimates were made it is evident that the scope of the plan and the publicity cannot but be beneficial. The next great step is inspection and standardization of hospitals. This also must be undertaken in a large-minded way. In the October number of *The Modern Hospital* the editor, Dr. J. A. Hornsby, author of the recent book of the same name,[3] takes the ground that the

[2] Carnegie Foundation Reports on Medical Education, Bulletin 4, 1910.

[3] The Modern Hospital, Saunders, Phila., 1912.

[1] Read before the Chicago Gynecological Society, November 15, 1913. (See discussion, p. 649.)

physician is too close to the problems to solve them properly, and that he is often handicapped by working for a single department of his science. He argues, therefore, that one of the great foundations should make the investigation.

Does part of this investigation and standardization belong to our profession? I should say that the general surgeon or the special surgeon could best aid this work by analyzing a number of every-day procedures in the operating room or the ward, leaving questions of administration, of nursing organization, of feeding, of supplies, and the like to be studied by the efficiency engineer.[1] The time has come to urge that the national societies combine to undertake specific work in this direction.

In hospital management, until proper plans have been worked out, perhaps the most effective control in professional matters is by the clean-cut responsibility of one man committees. For example, the routine of the operating room is to be figured out, reduced to writing, and carried through by one of the surgeons. A careful consensus of opinion on the part of the various operators is scheduled and an average or standard technique agreed upon. Thus, let us say, two lengths of ligature are specified as regular, and three sizes of catgut, and nine different needles, which must always be ready. A routine form of skin preparation is to be employed unless a different one is specifically ordered. These are only examples. The individual equation and initiation are not handicapped, but departures from standard are recognized as such and radical alterations are matters of conference or arrangement. Thus what was haphazard becomes systematized, well understood, economical of time and material. Histories are placed in the hands of one man, who enforces a standard nomenclature of diseases and operations and an irreducible minimum of entries; the ward routine is in charge of another, who sees that not tradition but typewritten regulations rule. The dispensary, in professional matters, is administered by a third. Subcommittees or substitutes are allowed, but authority and responsibility are sharply defined.[2] Such men might be called the functional foremen of the health factory, bound over either to make good or to make way, being an effective executive committee, presided over by the man who appoints them, the president of the staff, and reporting to the staff, which is annually named by the trustees.

*Clinical Travel.*—Too much stress cannot be laid on the astounding stimulus systematic visiting provides for the overhauling and practical review of one's methods and resources. Not sporadic and occasional visiting, but that done at regular intervals with every second or third year a longer trip affording opportunity for making wide generalizations and time in which to do steady thinking. Any small group of men may, within six years, in reasonable vacations, inspect all the best clinics in their own line in this country and in Europe.[3]

In their travels selection may be made of those clinics whose efficiency will best repay an analysis looking toward the standardization of others. The example that springs first to mind is the Rochester clinic. The definition of authority, responsibility, and system in certain institutions; the remarkable teamwork in individual operating rooms; the laboratory equipment of some surgical departments, the follow-up methods of others; the impressive teaching devices of one man, the student's participation under another; the high average technique of a whole city—the best can be selected for study and emulation.

*Illumination.*—As an instance of the need of scientific studies let us take the subject of the illumination of the field of operation when that field is in a cavity like the vaginal canal or the laparotomy well. Hitherto all stress has been laid upon the attempt to get light as brilliant as possible. One way is by large skylights and windows, another by electric bulbs with reflectors, a third by the beam from an arc light outside the room reflected from one or more mirrors, as in the larger German clinics. As far as I know no study

[1] Reports by the Committee on Hospital Efficiency to the Philadelphia County Medical Society, June 17, and November 26, 1913.

[2] Dickinson. A Visit to Brooklyn Hospital. Long Island M. J., 1910, November.

[3] Dickinson. Clinical Travel, Brit. M. J., 1913, Oct. 18.

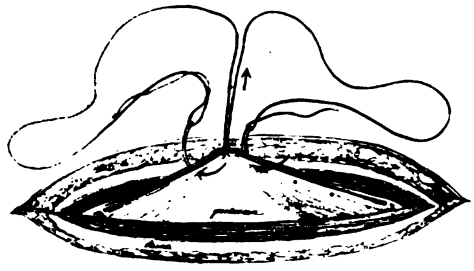


Fig. 1.

Fig. 2.

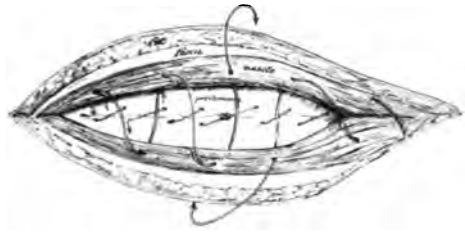


Fig. 3.

Fig. 1. Simplified method of closure of the abdominal wound, eliminating needle holder, several clamps, thumb forceps, and retractors. The peritoneum is picked up by a middle tie stitch; operator and assistant whip over toward the angles at the same time.

Fig. 2. The peritoneum is closed and the same stitch starts to close the muscle. It may be tied at each angle if desired.

Fig. 3. Longer sweeps approximate the muscle and the stitch is tied in the center of the wound.

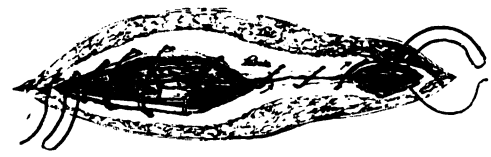


Fig. 4.

Fig. 5.

Fig. 6.

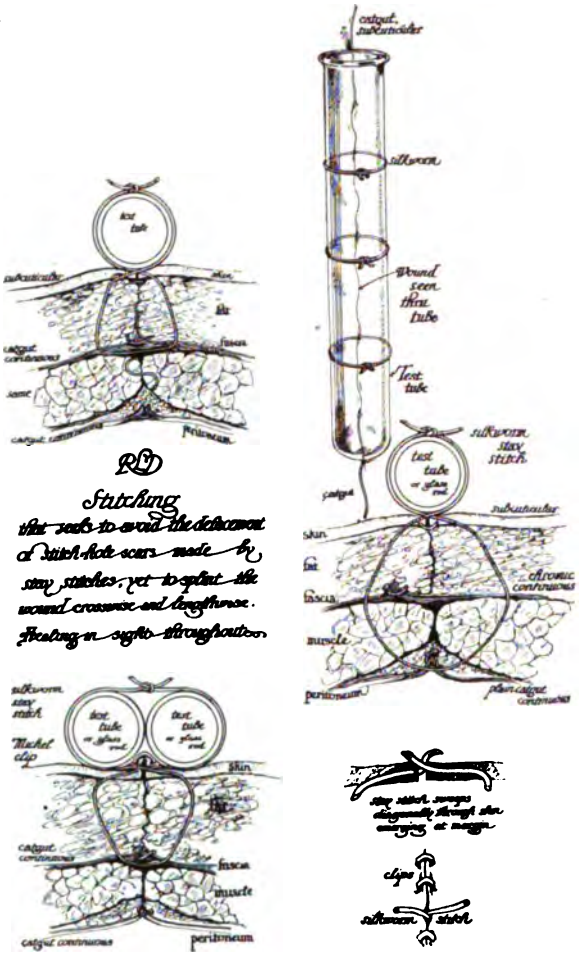
Fig. 4. The same strand goes on in two directions to close the fascia, beginning at the center.

Fig. 5. The fascial layer suture ends with a tie at each angle; this usually completes the layer suturing.

Fig. 6. Longitudinal section of wound. If desired, the same stitch may be used as a subcuticular, tying in the center of the wound with a knot that hides itself beneath the skin.

has been made of the results in their bearing on the surgeon's retina. One's first idea would be that the brighter and more abundant the light the better. But this is not true. Indeed the paradox is truer that the more brilliant the general illumination the less will the eye see into deep caverns. The pupil contracts from the strong illumination of the entire room and particularly from the glare on white sheets and towels encircling the field. The eye is handicapped. With the beam thrown directly into the cavity the conditions are better but not yet right so long as the surroundings are all white. The most desirable arrangement would seem to be a room with ample light to enable the nurses to find instruments and thread needles, with a beam of light thrown into the wound from more than one direction and the covers about the wound of a color of the same actinic value as the pink and red surfaces within. Black sheets look dingy. Red rubber (fortified with fabric) is an example of a color value of about the required intensity.

For night work it was long accepted that the ideal conditions for reading existed when, in a dusky room, a bright light was centered on the page, as by a shaded lamp, and in an operating room when a group of lights was equipped with reflectors to focus the light rays and with a glass screen to stop the heat rays. The eye men, however, have taught us that under these circumstances the pupil adjusts itself to the general darkness of the room and opens wide. Hence the spot of brightness hits the retina a blow. If this be true, then, in night operating, with a brightly lighted field, the rest of the room should show diffused lighting, and the environs of the wound a color value not far from that of the area on which work is being done. But this whole subject, as well as cross lights, sky-




Figs. 7, 8, 9. Stay stitches that leave no stitch-hole scar, the test tube being used as a bolster and a slanting grip of the skin edges taken.

light, summer glare, and so on, calls for the kind of study for which we plead.[1]

*Abdominal Incision.*—Suppose we select another every-day problem for time study and motion study, with the proviso that we all deprecate mere operating against the

[1] Grober, Das Deutsche Krankenhaus, Fischer, Jena, 1911. pp. 169, 172, 315, 536.

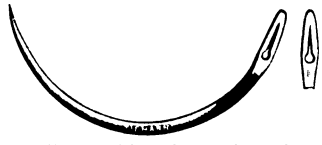


Fig. 10. Needle in which thread jams in a pointed eye so that it cannot slip out during operation (McRae).

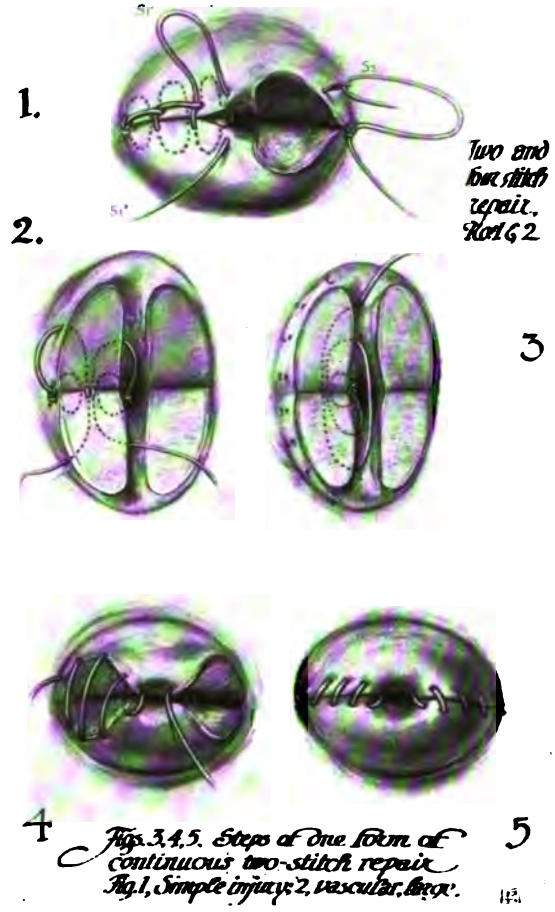



Fig. 11. Various forms of continuous suture as applied to cervix repair. These may be submucous in location.

clock. In closing the abdominal incision, what is the swiftest simplification compatible with good workmanship? Restriction of the number of assistants and tools and motions with selection of the best of these in the best sequence—that is the matter for study. The irreducible number of tools would be a needle and a suture. Can we dispense with needle holder, retractors, the several clamps used to pick up peritoneum and fascia, and thumb forceps? Can some knots and sutures be eliminated? Can two men work simultaneously on the larger incisions?

Let us, then, on the simplest possible scale undertake various trials. Let us test this, for instance. A No. 1 plain or No. 0 chromic

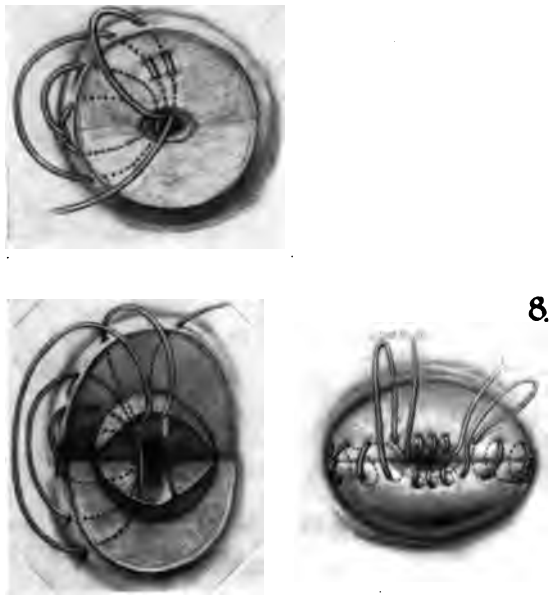


Fig. 12. Continuous suture in amputation of the cervix by a suture from each side.

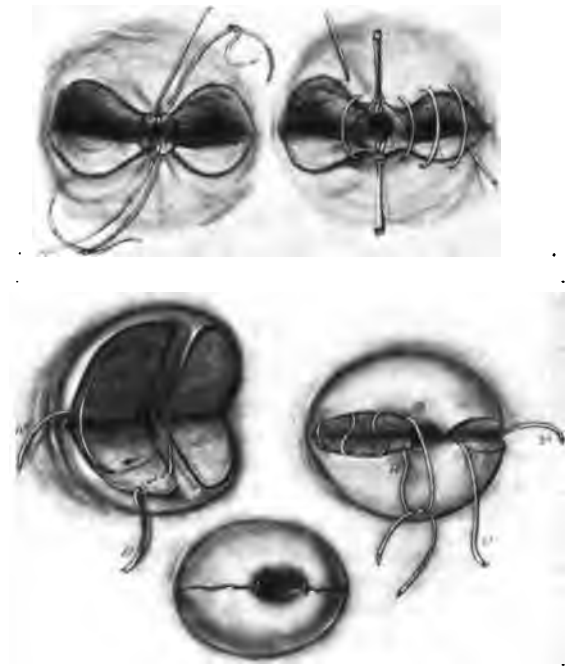


Fig. 13. Amputation of the cervix by two continuous sutures, the start being made in the center line.

catgut (20 to 28 inches long, according to the length of the incision) is armed at each end with a needle large enough to be manipulated without a needle holder and sharp enough to cut the skin but not to slice blood vessels (e. g., the Mayo-pointed). Two fingers pick up the peritoneum at the middle of the incision, and the suture is passed first through one side and then through the opposite peritoneal edge. The strand is tied midway of its length. After tying, traction lifts the peritoneum out of the wound in tent shape, exposing the upper and lower ends of the incision in this membrane (Fig. 1). The operator, in a continuous whip-over, closes the gap in the direction of the pubes, while at the same time his assistant, in all wounds but small ones, does the same in the direction of the navel. Having closed the peritoneum (Fig. 2), the same strand now doubles back, in longer sweeps, to approximate the muscle edges (Fig. 3), the two ends meeting in the middle of the wound, to tie there. Next (if thought desirable) the same stitch may whip the fascial edges together (Fig. 4), tying at the upper and lower ends of the fascial incision (Fig. 5). Indeed one could carry the scheme still further and use the same stitch for the fat layer or for a subcuticular, if one elected to indulge his fancy to the limit (Fig. 6). Naturally if plain catgut is used, silkworm stay sutures should supplement the support of the fascia. If one prefers plain catgut for the two lower layers and chromic for the fascia, the center-started stitch saves time here also, with incisions five inches or over. If stay sutures are employed, these may be so placed as to leave no stitch hole scar by crossing them at their exit from the skin margins of the wound and tying them over a bolster, which may be an ordinary test tube laid along the wound (Figs. 7 and 8).

The above are suggestions for trial. Many data there are to be worked out and individuals will give very different answers. The Michel clips, for instance, are commonly used in Germany for closure of the skin because of the speed of the procedure, and a long straight cutting needle, like the Keith, facilitates the placing of the subcuticular suture. The end results as to suppuration, broad and tender and unsightly scars and

Fig. 14

Fig. 15

Fig. 14. Hysterotomy of both lips. Direction in which continuous sutures should be placed.

Fig. 15. Perineal repair by chromic gut. Frequent pussy appearance of stitch-holes as stitches drop out or are removed.

hernia—all these are matters for such study as we are here advocating.

In this connection one might propound yet another problem. What is the best method of shielding the abdominal incision from friction, contusion, and infection? Concerning this I have long taken notes and have found precautions generally ignored or abandoned. I believe that no adequate solution has been worked out. Perhaps my shield retractor of rubber fabric with two springs may prove to be such in suitable cases (Fig. 21).

As a single example of the standardization of tools, a study such as we urge would make prominent a needle, a device twenty years in use, which seems to have escaped the notice of most surgeons, possibly because it was never published. A tapering eye jams the suture and prevents that not infrequent minor annoyance and delay, the slipping of the thread from the needle. When well made it does not cut the suture. It would seem that this MacRae eye should become standard, perhaps *the* standard (Fig. 10).

One more example, this time in training of right habits in handling instruments. Which is least fatiguing? The great German operators keep the gaze fixed on the field, reaching out a hand and calling for the next instrument. Thus the eye does not have to find an instrument and then re-focus on the exact

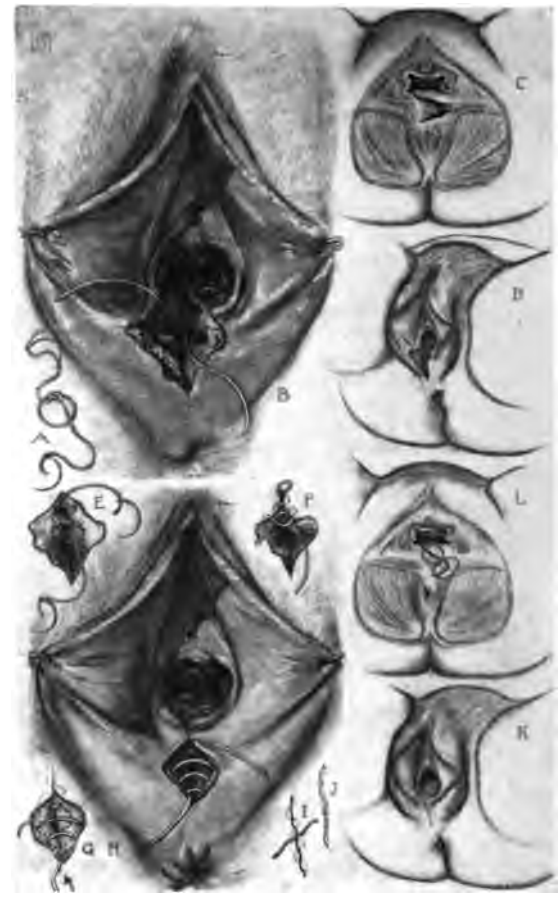


Fig. 16. Primary perineorrhaphy by layer suture, single strand, subcuticular. A anchorage in deepest portion of wound; particularly effective in irregular forms of tear. Result is accurate coaptation (L) almost invisible line of union (K).

point selected for seizure or suture. Again, Dr. F. F. Simpson does not have to look away from his work because each instrument, of those repeatedly used, lies in its own place, and there his hand finds it and there his hand replaces it. The commonalty among us sheds an instrument somewhat haphazard and has not only to look, but to search and select among a group, in recovering it. The new analysis studies all these ways. It might even consider whether a hand signal for an ordinary instrument might not save that delay or that mental annoyance of the moment when, intent on a grave issue, one must withdraw one's mind to form and voice

Fig. 17. Secondary perineorrhaphy by continuous catgut layer and subcuticular. The test of the rectocele (1, 2, 3,) and the guide to the levator (4) being made by stick sponge in the rectum. 11 and 12 show three and four layer method respectively.

Fig. 18. The gauge of the amount of denudation. a-Kocher clamps seize remains of hymen and draw them over two fingers. b-Another grip, with another pair up lateral vaginal walls makes test further in. Stick sponge in rectum facilitates suture of levator.

the word "clamp" or "scissors." If Dr. Cochem is trying with his trained crew to develop silent operations he might go further and develop what might be aptly termed "pantomime operating." However this may be, when we train golfers, boxers, runners, to standard form and secure 100 per cent efficiency, why not laparotomists?

*Repair or Amputation of the Cervix by Continuous Suture.* — The usual cervix operation presents a tangle of multiple ties, say four on each side. Each stitch is taken, clamped, laid aside, until all are in place. Then they are unraveled from the bunch, right and left, and tied one by one, each being again laid aside after tying. Lastly scissors are taken to the whole group. It is found that the same result may be attained by two continuous sutures, with four knots instead of six, eight, or ten. Any one of three or four adaptations of the two-stitch method are available. A relatively thin cervix may be treated with a buttonhole suture with its crossings on the vaginal surface of the cervix (Fig. 11, "1"), using one stitch for each side of a bilateral laceration. When the cervix is somewhat voluminous and the tear long, Pomeroy uses two layers. The first turn and tie of the stitch is placed high in the cervical canal laterally, and then this lateral wall of the cervical canal is built down to the external os. From this point the same suture may be

Fig. 19. Primary perineorrhaphy with identification of torn levator and continuous suture of the injury by drawing the retracted muscle from the gully alongside the rectum forward toward the pubic arch.

continued outward under the vaginal surface of the cervix to the cervicovaginal junction (Fig. 11, "2 to 5"). As a rule, however, both sides of the canal are built before the external portion is added.

In amputation of the cervix the sewing may be begun at the outer angle and run inward (Fig. 12). The best way, however, is to start the stitching by a center sweep, with one end for the posterior and one for the anterior lip (Fig. 12, "8"). Each end serves as tractor and as a guide to the median line. The end with the needle is then run as a continuous suture, the rear stitch toward one side, the front stitch toward the opposite side (Fig. 13).

In those instances when pelvic floor repair is postponed to some time between the second and tenth day post-partum the uterine injuries should be mended at the same time. Continuous suture best effects this. A simple buttonhole stitch is easiest. If with two layers, one starts at the inner end within the cervical canal, grasps almost all the thickness of the cervix, and thus works down to the external os. Thence a submucous stitch, more or less exact, runs along the vaginal aspect of the cervix if necessary (13A). Pomeroy begins on the vaginal surface of the cervix at the rear in double hysterotomies, by running or buttonhole suture; next, the canal side; then with the second stitch, the opposite canal side; last, the remaining anterior vaginal aspect of the cervical lip (Fig. 14). In other words, the far side is done before the near side.

As skill is attained in all these procedures the outer layer is hidden so that no stitch and no knot is in view, but only a line of coated incision.

*Perineorrhaphy.*—For saving time and elaboration in perineal repair the one-strand, two-knot continuous suture has been found to be the simplest device. In most operations, whether primary or secondary, the center of a long suture may sweep and tie in the deepest part of the wound (Fig. 16 A, B), then the two ends whip over, one upward to close the vaginal gap (Fig. 16 E), and unite the mucous membrane over and over, or by a submucous stitch (Fig. 16 F), the other downward toward the anus (Fig. 16 H), finishing as a subcuticular, to tie to the first part (Figs. 16 I and K and 17 Fig. 17, "9" ). We are ready to declare that upon buried catgut of small size entire reliance may be placed for pelvic floor repair after labor. It is even more satisfactory than in secondary operation. In our 58 fresh injuries of various degrees primary union resulted in all but one. We used either interrupted stitches closed over by running intercutaneous lacing, or tier suture with several strands, the last being subsurface; or else, as I prefer, a single strand run as continuous tier suturing, with two ends coming together, one submucous, the other subcuticular, the whole secured by one deep knot and one hidden surface knot. In any of these ways the

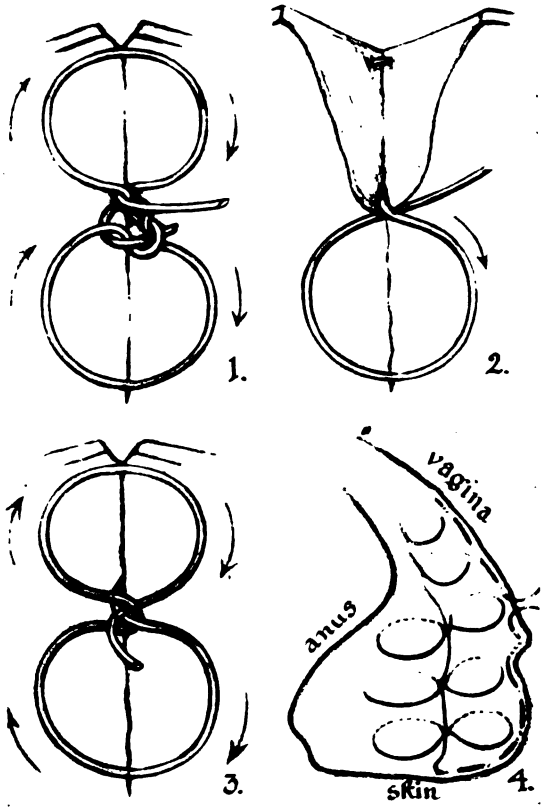



Fig. 20. Three tier suture, by the employment of the figure 8, which is continuous and middle-locking.

wound is practically invisible from the first. Levator laceration found immediately after labor particularly demands tier suture, and anterior fascial gaps are thus best united.[1]

In late perineorrhaphy, as now customarily done, where the levator muscle and fascia are drawn inward from the lateral sulci to be fastened side by side in front of the rectum (Noble) the single strand stitch works well. A convenient beginning may be made by placing the first sweep and tie at a point about two-thirds of the length of the suture and at the middle of the lateral bands that are to make the reinforced septum (Fig. 18). Traction on this stitch pulls down within reach the spreading V of the bands higher up so that a sweep may be carried beyond to draw these together (Fig. 17, "5"). This portion of

[1] Dickinson, Buried and Subcuticular Catgut in Primary Perineorrhaphies. N. Y. M. J., 1914.

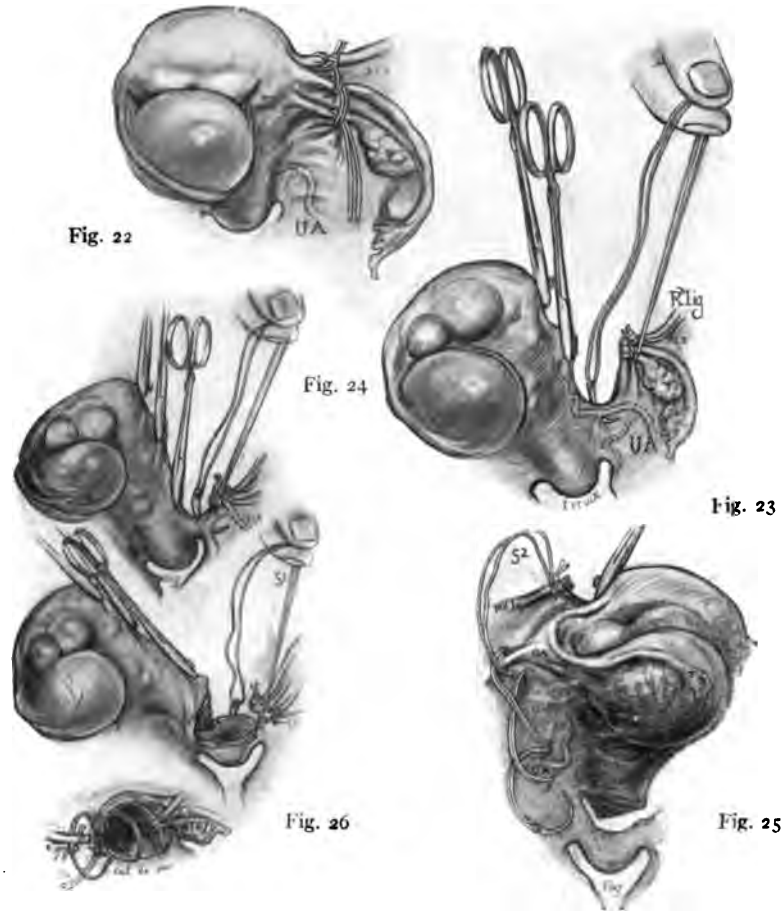
Fig. 21. Shield retractor guarding cut surfaces in abdominal wound.

the suture is thereafter of service to gather the rectal wall and to close the upper end of a Hegar triangle and eventually becomes a mucous membrane stitch or submucous lacing (Fig. 17, "6 x 9"). The end then hangs loose to wait for the completion of the operation, when it ties to the subcuticular coming back from the anal region (Fig. 17, "9").

Let us now return to the knot in the levator (Fig. 17, "7"). To draw together these bands three stitches are often desirable. Two have been placed. The third is now swept about the edges, and best from left to right (Fig. 20, "1"), in order to make the next stitch effective. It then takes any available order. To close the transversus and sphincter vaginæ muscles and then the superficial fascia either two (Fig. 20, "4") or three more layers (Fig. 17, "11 and 12") are employed. The aim is to have brought together everything but the skin on arrival at that end of the wound nearest the anus, so that the intercutaneous work may proceed toward the hymen and meet the first end there. If there be tension a stay stitch or two may be used.

Such one-stitch repair is a matter of practice. On small injuries it is easy. On the larger it works well in properly selected cases.

In levator lacerations, primary and second-




Figs. 22–26. Steps in the two stitch abdominal hysterectomy. Each loop is drawn taut before proceeding, and kept taut, serving also as a tractor. Into the deeply coned cervix — or vaginal edges — the round ligaments are made fast.

ary, the torn end of the pubo-coccygeus drops backward alongside of the rectal wall as, in a more superficial plane, the sphincter withdraws into a pocket. For anatomical replacement and the drawing forward of the hidden end toward the ramus the continuous suture is found to work better than the interrupted. (Fig. 19.)

*Hysterectomy.*—The elimination of waste motions in removal of the uterus led to combinations of ligature, suture, and tractor in one, intra-abdominal work I owe to Dr. F. F. Simpson, and the vaginal procedure is my application to the operation of Dr. J. Riddle Goffe. These methods are for the expert, and even he may, perhaps, at the first trial, combine the ligature with this suture.[1]

In simple cases two sutures suffice. I sometimes use more. It is spoken of as a two-suture method because the work usually can be done thus. There has been no slipping, no hæmorrhage, no death, in a series of forty-two cases.

*Abdominal Hysterectomy.*—The first bite of the suture is usually that which circles the round ligament (Fig. 21). The second stops bleeding from the ovarian artery (Fig. 22). In each case care is taken to bite into and

[1] Dickinson, Hysterectomy by Two Suture-Ligatures. J. Obst. & Gynec. Brit. Emp., Sept., 1913. Tr. Internat. Cong., Lond., 1913.

lock into tissue so that the ligature does not slip off a bared vessel. In every case and with every bite the loop must be snugly nestled home without slack or jump or stretch of gut between the bites, except as noted hereafter. Reflux being checked by a clamp on the uterine side, the upper vessels are cut away (Fig. 23). The thin part of the broad ligament is scrutinized. If it exhibits a bunch of varicose veins, sweep number three should encompass them (Fig. 27). We now cut away down toward the uterine, shoving back the bladder in front and peritoneum behind to bare or nearly bare the artery. The next sweep circles it (Fig. 23) and locks home (Figs. 24 and 28). The vessel is cut. The last sweep of the stitch as a ligature circles the vessels just to the side of the cervix (Fig. 24), and should get some grip in cervical or vaginal tissue for traction purposes.

Now one may with advantage repeat the procedure from the opposite side (Fig. 25). And for this reason. These suture-ligatures make convenient cervix tractors, and we may often dispense entirely with other clamps than those used to prevent reflux bleeding. Next, the uterus is cut away, taking care to cone the cervix in such fashion as to leave little or no cervical canal (Fig. 24). The cervix stump swings between two tractors, namely, the ligatures. One of these next approximates the two faces of the cervix crater, taking care to turn into this raw surface the cut ends of the round ligaments (Fig. 26), and it is then tied to its fellow of the opposite side. Finally, the second suture becomes the peritoneal suture and closes in all raw areas (Fig. 29). At any step in the process one may tie the strands, then go on with them. When the cervix is to be removed the same procedure holds good, substituting the words vaginal edge for cervix crater.

The same principle is applied to large uterine and ovarian tumors and pus-tubes, and to broad ligaments however distorted, by a variation in the procedure. Whenever there would be, between one artery and the next, a gap or space, and this would be crossed by a span of suture that could not be drawn taut, each artery can be securely grasped without altering the principle of this method.

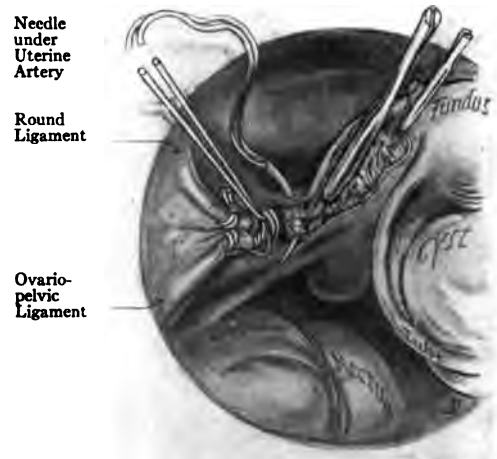



Fig. 27.

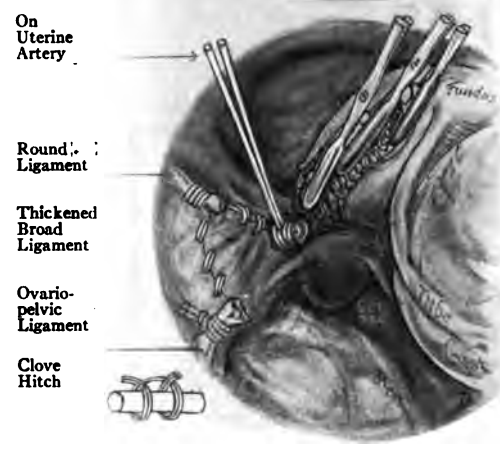



Fig. 28.

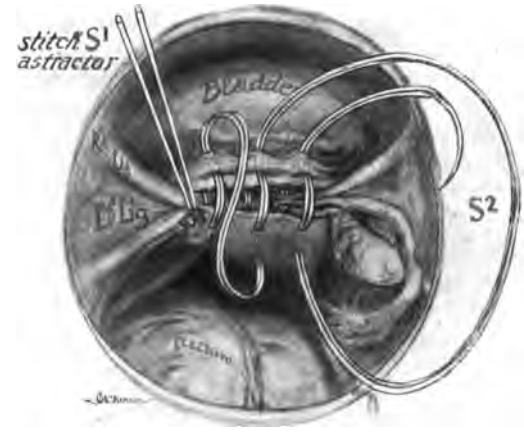



Fig. 29

Figs. 27, 28, 29. View into pelvis — stitches drawn large — to show closure of broad ligament at each step of ligation, and effective tractor action. Fig. 28, double bite, or clove hitch, used when any slack or line of delicate stitching intervenes between ligature action. Fig. 29. Peritoneal apposition over stump.

Figs. 30–31. The continuous double suture climbs the broad ligament; the second loop, here nestled home, circles uterine artery (UA). Second cut of ligament has been made. Tractor action shown. Fig. 30 — A small fundus may be extracted, then round ligament, then tube and ovarian vessels grasped by lock stitch. Or uterus may first be bisected. Or, on upper section of broad ligament, lock stitch may follow clamp and cut.

The vessel is to be caught in one loop, and afterward by a second—the second locking the first by the familiar clove hitch (Fig. 28).

Thus between the location of secure ligatures on several vessels, there can be lines or areas of mere suturing, all cared for by the same running strands (Fig. 28). The advantage is not only simplicity and speed, but also this: one does away with the curious and general practice of laying open wide raw spaces of connective tissue and then covering them in later. By coapting before cutting—or immediately on cutting—one closes the denuded areas, as it were, before creating them.

*Vaginal Hysterectomy.* The drawbacks to the lower route have been slowness and fussiness; occasional slipping of ligatures; oozing from broad ligament bases that spread wide open and retract into the bloody dark, and wide raw areas left uncovered by peritoneum.

If, by means of a long suture-ligature-tractor for each side—of fine, plain catgut, doubled—one sweeps about the vessels while he closes together and climbs and pulls down broad ligament, all by steps in the same process, then cuts the uterus out; thereafter, with one of the same stitches sews the ligament masses together, closes the peritoneum of the cul-de-sac, and cares for the posterior vaginal gap; with the other unites the anterior peritoneum, anchors the bladder, and cares for the longitudinal vaginal incision, all by running continuous suture,—he has, by a succession of well-reasoned movements, planned for the four requisites. The steps are as follows:

After the bladder is pushed back and the cul-de-sac opened and the base of broad ligament seized, cervix and stitch are pulled in different directions and a cut made between. This, or a second loop and cut, takes us close to the uterine artery. This sweep bites into tissue to anchor it and then circles the artery, is looped and carefully nestled home, and kept taut by the assistant (Fig. 30). Rarely a second, or locking loop, is applied. Next, the opposite side is treated in the same way. Now the uterus comes down so that the anterior

Fig. 32.

Fig. 33.

Fig. 34.

Figs. 32, 33, 34. Quilted broad ligaments ready to be sewed together. After anterior peritoneum is closed (not shown), bladder is sutured to top or rear of this strong bridge, Fig. 31. Cul-de-sac whipped over, then transverse and longitudinal vaginal openings approximated, catching the vagina up to the ligaments also.

peritoneal pouch is accessible for opening and widening. The fundus is drawn out. The suture either takes two more bites, round ligament in one (Fig. 31) and tube and ovarian ligament in the other before one side of the uterus is cut free, or else a clamp is applied, and after the uterus is out these stitches are taken. One must be careful to puncture and grip good tissue to prevent slipping,—for example, in the ovarian ligament. The upper end is now tied, shortening the broad ligament. The suture is not cut, however. The opposite side is treated in the same fashion. Care must be taken that in the jump between the ligating loops safe-guarding the lower portion of the broad ligament and those controlling the ovarian and round ligament vessels, there be no slack or span. The stitch should now be tied, and then continued to sew broad ligaments together, make fast the bladder and close the vaginal incisions.

## CONCLUSION

If in all other workshops time, study, and analysis have resulted in doubling, with the same expenditure of energy, the output of the worker or cutting in half the time required to do a certain piece of work,[1] then the activities of all concerned in operating room and ward must be subjected to such study. Otherwise the profession is neglecting its plain duty. It now behooves us to call in the expert on scientific management to apply in our business of saving life and health whatever may be transferred from his experience in other fields. Each one of us may help by recording analysis and experiment in his own particular province, in those matters, such as details of operation, of which no outsider could be expected to have sufficient understanding.

[1] Gilbreth, Primer of Scientific Management, 1912.

# PRELIMINARY REPORT OF EXPERIMENTAL WORK IN BONE TRANSPLANTATION[1]

By E. J. LEWIS, M. D., Chicago
Instructor of Surgery, Rush Medical College. From the Nelson Morris Research Institute

THE question of bone transplantation and regeneration is one that has been before the profession for many years; in spite of which fact, no generally accepted opinion exists as to how or from what tissues the new bone is produced.

A brief review of the literature indicates how unsettled our ideas are upon this interesting and important subject.

Barth (1), in the Surgical Congress of 1893, stated that "all living transplanted bone died immediately whether with or without periosteum and that it was unimportant whether living or dead bone was used."

Axhausen (2) says: "There can be no doubt that fresh bone tissue planted in a defect dies throughout but that the periosteum remains alive and capable of reproducing bony tissue and it is probable that the bone-marrow retains its vitality."

Beattie (3), in his textbook of pathology, published in 1909, says: "The periosteum is composed of two layers, the inner being highly vascular and containing numerous osteoblasts. In operations on bone it is important not to injure this osteogenetic layer of the periosteum. The power to form new bone is not, however, limited to the periosteum, but is also exhibited by the tissue in the cancellous spaces and the medullary cavity."

Wieder (4), of the University of Pennsylvania, in a study of the healing of fractures in 1907, observed that "the bone-cells are confined and slow to react. They only form bone when liberated. The periosteum is early and free of reaction. The endosteum is most active. Both the periosteum and endosteum produce osteoblasts and osteoclasts."

Janeway (5), in 1910, in mentioning the few who at that time maintained the viability of the bone graft, stated that "all others have recognized the death of the implanted bone, its revascularization and penetration by granulation tissue, and, through this means, the production of new haversian canals, the lining of the new vessels with osteoblasts and the deposition of new bone in concentric layers around the newly formed blood-vessels." He also recognizes that "these changes are solely dependent upon the living and regenerative powers of the transplanted periosteum and marrow."

John B. Murphy (6), in 1912, in a very complete discussion of the surgery of the bones, joints, and tendons, concludes as follows: "Bone without its periosteum transplanted into muscle and cellular tissue always dies and is ultimately absorbed. When transplanted as above, with its periosteum, it practically always dies except in infants or very young children. If transplanted with or without its periosteum in the same individual and contacted with living osteogenetic bone at one or both ends, it acts as a scaffolding for the reproduction of new bone of the same size and shape as the transplanted fragment. The transplanted fragment, no matter how large or how small, is always ultimately absorbed."

Streissler (7), in an exhaustive review of the subject, says that "the best material for transplantation is living periosteum-covered human bone preferably from the patient himself. Bone transplanted without periosteum undergoes absorption and, therefore, should not be used for transplantation. Periosteum can be transplanted by itself and remain alive. It grows bone even when removed 100 hours after death in rabbits. (Bone-marrow when transplanted alone has osteogenic powers.)"

The publication of Macewen's book on the "Growth of Bone" (8), in 1912, with his many convincing experiments has resulted in a great stimulation to the experimental side of this question. His conclusions, briefly stated, are as follows: "The periosteum is not osteogenetic. The osteoblast has independent vitality and proliferative powers

[1] Read before the Chicago Surgical Society, March, 1914. (See discussion, p. 645.)

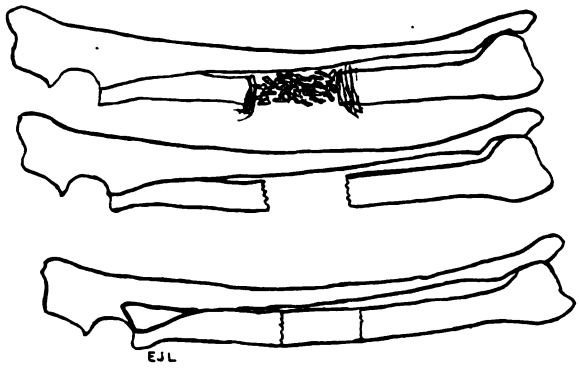


Fig. 1.

in the bone and soft tissues. The diaphyseal ends of the epiphyseal cartilages have great inherent reproductive power."

Cotton and Loder (9), in a report of an experimental study of the fate of bone grafts, report "uniform survival and healing in of graft, and, microscopically, a rapid covering of the graft by new endosteal bone laid down by the activity of the endosteoblasts in all portions of the graft, center, and periphery."

In contrast with these conclusions, Haas (10), in a series of experiments studying the regeneration of bone from periosteum, found that in working on the ribs, "Isolation of the rib from its periosteal bed caused atrophy with never any evidence of proliferation, nor was any evidence of union found in fractures produced in periosteum free bone. The severed ends of the denuded ribs inserted into the muscles never showed evidence of regeneration. New bone, forming at the angle of separation of the raised rib and periosteum seemed to follow along the periosteum and grow better in blood-clot. He believes that the combined action of the periosteum and blood-clot was responsible for the formation of the new bone."

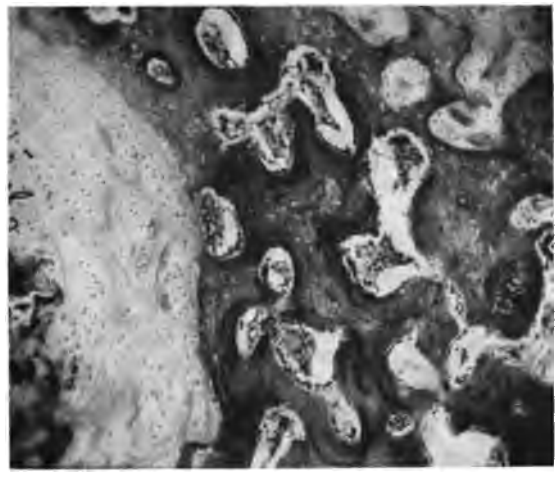


Fig. 3.

McWilliams (11), who has been one of the most persistent investigators of this subject from the experimental as well as practical point of view, concludes in an article published less than one month ago that "living bone grafts have life inherent in themselves and that the theory that contact with living bone is necessary for the subsequent life of grafts must be given up." He goes on to say that "93 per cent of periosteum covered grafts survive while 48 per cent of his bone grafts

Fig. 2.

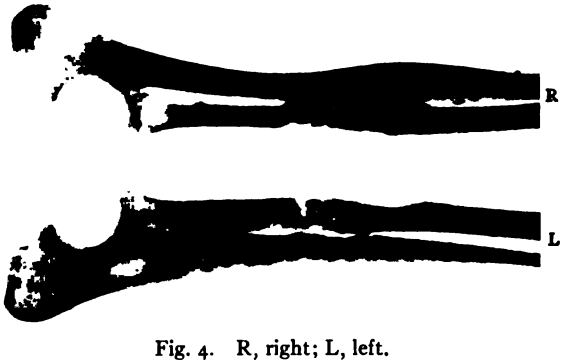



Fig. 4. R, right; L, left.

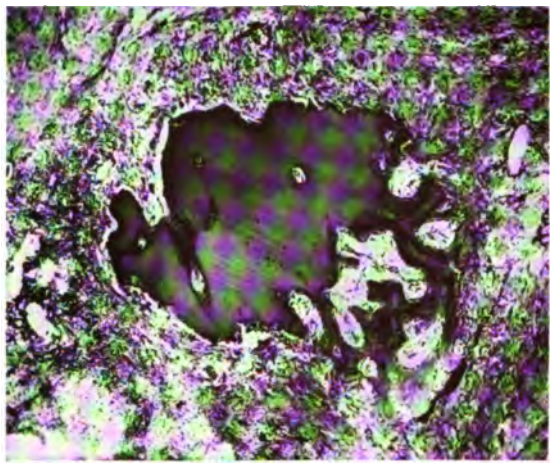


Fig. 5.

without periosteum lived. Also that in a certain number of cases he was able to produce new bone from periosteum transplanted into the soft parts."

The fact that a microscopic examination is necessary to determine whether a transplant has survived or merely "grown in" makes it impossible except in rare instances to draw conclusions from the many reports of successful bone transplantation in the human.

The contradictory results obtained by careful observers in the work or even by the same observer in a series of experiments can, I believe, be explained by the variations in one factor; namely, the amount of blood supply which the transplanted bone obtains. If we can prove that the bone-cells in a transplant can live and grow, we have the right to draw an analogy with the knowledge which we possess concerning the rules for skin-grafting where we have long agreed that, at any rate in autoplasts, the essential factor in obtaining a favorable result is the establishing of a sufficient blood-supply. I see no reason why the physiologic reaction of a bone-cell should in any essential degree differ from that of an epithelial-cell.

We have all known of failures in skin-grafting because the transplant failed to "take," or in other words to obtain sufficient nourishment for life and growth. The same explanation can, I believe, be made to hold good for our results in bone work.

It has been with this idea of blood-supply in mind that I have been working for the past year. The cases cited in this report have been limited almost entirely to the one phase of the problem which I consider essential as a basis for further work; namely, the study of the cortical bone itself distinct from its periosteum and marrow in an attempt to prove the viability and proliferative powers of the bone-cells which are therein contained.

This work has been done at the Nelson Morris Research Institute and a total of twenty-seven dogs have been operated upon thus far, of which reports concerning eight have been included in this paper.

Transplants from the same animal were used and the work was done as far as possible upon young dogs. The usual technique was to resect three to four centimeters of the shaft of the radius or ulna. The resected fragment was then split and the periosteum, endosteum, and marrow thoroughly curetted away. In order to obtain the best possible nourishment, the resected bone was then divided into many small fragments averaging three millimeters in diameter and one millimeter in thickness. The opposite leg was used as a control in some of the cases and the same technique followed here, except that the bone-cells in the fragments were killed by boiling for five minutes before use.

The many fragments of bone prepared as above were replaced in the cavity left by the original resection. In some cases the adjacent cut ends of the shaft were allowed to remain open, in others the ends were closed by periosteal cuffs or fascia and muscle flaps. After the fragments were replaced, the overlying muscles and skin were closed with catgut and plaster casts were applied for from

Fig. 6.

two to three weeks. The drawing (Fig. 1) shows roughly the general method followed in most of these experiments.

Experiment No. 1. Dog No. 11. Gives the findings nine weeks after operation in a case where the bone had been prepared as described above and had been replaced in the original cavity, the adjacent ends of the shaft being left open. The X-ray (Fig. 2) and the post-mortem examination established the fact that complete bony union of the many small fragments had occurred. The new-formed bone was irregular in outline and increased the diameter of the radius about one-half at this point. There appeared to be no interference with the interosseous membrane and pronation and supination was free.

The report of the microscopic examination (Fig. 3) is as follows: The section was removed from the upper end of the irregular mass of bone so as to include a portion of the old bony shaft and the new bone. Live, actively growing new bone was to be seen throughout this section firmly uniting the original transplants to one another and to the end of the shaft. No evidence of "growing in" from the end of the shaft was observed. Throughout the entire section it was only possible to find one or two of the transplanted fragments which had failed to survive. The rest were all alive and apparently actively engaged in the production of new bone.

Experiment No. 2. Dog No. 14. This dog was posted in five weeks, the fragments having been prepared in the same way as in Experiment No. 1, the difference being that the left leg was used as a control. On the control side the fragments of bone were boiled for five minutes before being replaced. The ends of the shaft were left open on both sides. The examination at post-mortem shows a marked difference between the two sides. On the left side

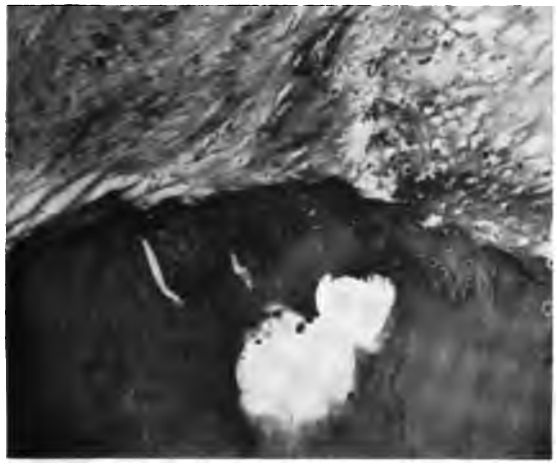


Fig. 7.

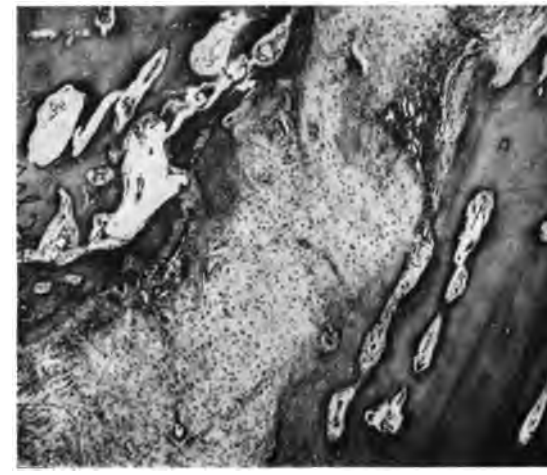


Fig. 8.

where the fragments were boiled before replacing there was a complete failure of union, the transplants being freely movable in a loose, connective tissue in which the individual pieces of bone could be felt. On the right side, a fairly good bony union was found to exist. Ossification, of course, was not complete and the new bone could be bent, but the fragments were all united in one mass and the surface of the new bone showed the irregular markings of inclusion of the original fragments in the growth.

The X-ray (Fig. 4) of the two sides bears out these post-mortem findings inasmuch as the separate particles of dead bone on the left side can be readily made out, while the fragments on the right side have grown together in a mass with a loss of definition in the outline of the original transplants. In this experiment, if the new bone were derived from the adjacent ends of the shaft, there should be no difference in the findings of the two sides.

The microscopic report is as follows: The section was taken from the firm mass of callus in the right leg. Throughout the section can be seen the original transplants of bone. Most of these have lost their cellular structure at the center, but along their periphery the bone-cells persist and in many areas bone trabeculæ consisting of osteoblasts and capillaries can be seen growing out into the granulation tissue or extending to near-by transplants uniting the grafts in one bony mass. The area included in the microphotograph (Fig. 5) shows one of the smaller transplants lying free in the granulation tissue. Along its entire periphery the osteoblasts can be seen laying down new bone and along one border a network of bone trabeculæ is seen to be growing out. There can be no doubt that this new bone is derived from the original fragments and that the growth is from the cortical bone and is independent of periosteum, endosteum, or marrow.

Experiment No. 3. Dog No. 17. In this case

Fig. 9.

the bone fragments were obtained as described previously, the difference in the experiment being that the post-mortem was held twenty-one days after the operation. The X-ray examination (Fig. 6) failed to show that ossification had taken place between the fragments, but it also indicated that there had not been any extensive growth from the adjoining ends of the shaft which had been allowed to remain open. The transplanted particles could be felt in the callus which was extensive but still quite soft. The microscopic specimen was made from tissue removed only twenty-one days after the operation and failed to show the extensive formation of new bone trabeculæ that was to be observed in the older sections. Except at the periphery of the grafts, most of the nuclei in the transplants have disappeared; however, along the margins of most of the bone-fragments are layers of actively growing new bone (Fig. 7). This same new bone layer can be seen lining the haversian systems and the spaces within the bone substance, probably indicating that on these surfaces the supply of nourishment permitted the bone to survive, whereas in the deeper and more solid portions the cells had perished from lack of nutrition.

Experiment No. 4. Dog No. 23. Examination was made after 35 days. In this case the fragments were prepared as described, but the adjacent cut ends of the shaft were sealed off by flaps of muscle and fascia. There was, of course, no union other than fibrous between the mass of transplants and the

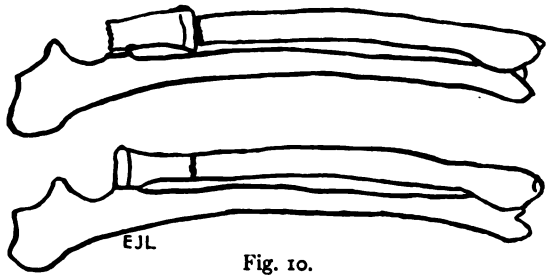



Fig. 10.

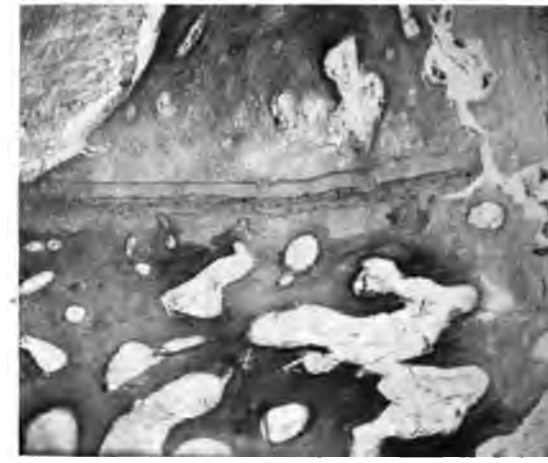


Fig. 11.

adjacent bony ends of the shaft. This mass was fairly firm but bony union could not be said to have occurred. The microscopic section was made to include the sealed-off portion of the shaft on one side, and the tissue between, containing a portion of the transplanted fragments. It shows very beautifully the effectiveness of the fascia and muscle-flaps in limiting the growth of the shaft into the open space. Below this limiting connective-tissue mass may be seen two fairly large fragments of transplanted bone (Fig. 8). They lie a short distance from one another and have grown together in one mass, the new material being actively growing bone and cartilage. From the appearance of this section there can be no doubt but that the new bone and cartilage tissue are derived from the original transplanted fragments. At other points may be seen small fragments of transplanted bone which have survived and which are serving as centers for new bone formation. In this experiment the sealing off of the cut ends of the shaft has prevented (if such a thing were possible) the entrance of osteoblasts into this area. In connection with this experiment I should like to show the X-ray (Fig. 9) of a case where the same technique was used as in Experiment 4, except that boiled bone was used in the sealed-off area on the left side as a control. The X-ray (taken thirty-two days after operation) indicates the extensive absorption of the dead bone that has taken place, the amounts of bone used originally on the two sides being approximately the same.

Experiment No. 5. Dog No. 12. This dog was posted nine weeks after the head and about three centimeters of the shaft of one radius had been removed, the articular surface scraped off and the fragment replaced with its original position reversed (Fig. 10). In other words the shaft end of the bone fragment removed was now adjacent to the elbow-joint. The periosteum was not removed

in this experiment nor was the adjacent end of the shaft sealed. No attempt was made to close the elbow-joint. The fascia muscles and skin were closed with catgut and a plaster cast applied for the first three weeks. No complications occurred, and when the dog was observed shortly before post-mortem he appeared to be using both forepaws equally well. On cutting down on the elbow, the joint cavity was found to be functionating and to have been restored to normal. A slightly increased amount of joint fluid was present. The end of the transplanted fragment adjacent to the joint had assumed somewhat the contour of the head of a radius and a bed of cartilaginous-like material had formed over it. Moreover, the capsule had become continuous with the covering of the transplant, so that, as stated above, there was a complete restoration of the anatomic relations in the joint as well as physiologic function. The distal end of the transplant was found to be firmly associated with the shaft of the radius. There was no evidence of atrophy of the bone. The microscopic report follows: The section was taken from the original transplanted bone and includes both epiphysis and diaphysis, with the epiphyseal line between. Microscopical examination (Fig. 11) establishes beyond any doubt the complete survival of this transplant. The cellular structure of the epiphyseal line can be readily made out and the columnar arrangement of the cartilage cells on the diaphyseal side is retained. The cell-nuclei retain their full staining powers throughout the entire specimen.

I do not think that any one will deny that this transplant lived and was not merely grown into by the adjacent bony shaft. If such had been the case, we would certainly not expect the survival of such a definite anatomic structure as an epiphyseal line, or the differences which we recognize in the appearance of epiphyseal and diaphyseal bone. The question of the possibility of transplanting the epiphyseal cartilage, with retention of its function of producing longitudinal growth, is a fascinating one that deserves careful investigation.

Incidental to this work I wish to report an observation of a case where a portion of bony shaft 3 centimeters in length was removed and the adjacent periosteum of the ends of the shaft thoroughly scraped away. The interval between the ends was then surrounded by a transplant of fascia which was made to extend up and down along the shaft for some distance. At the post-mortem nine weeks later complete bony filling in of the space with excessive callus formation had occurred. The fascia transplant had fused above and below with the periosteum and could not be differentiated from it.

In another experiment (Dog No. 13) the same method was followed except that no fascia transplant was used, the space between the ends of the shaft being allowed to fill with blood-clot. In this case no periosteal or bony bridge was allowed to remain, in spite of which fact, at post-mortem nine weeks later, a good bony filling in of the space was found to have occurred.

I wish to submit the following conclusions based on the experiments reported on:

1. That cortical bone, free of its periosteum, endosteum, and marrow will retain its vitality and proliferative powers when subdivided into small fragments and replaced in the tissues. Also that contact with living bone is unnecessary for the growth of these transplants.

2. That larger pieces of bone may be transplanted and remain alive—not being merely grown into by the bone in which they come in contact.

3. That bones may unite after fracture or a space fill in after resection without the aid of any periosteal or bony bridge, and that transplanted fascia may be made to take up the nutritional and limiting functions of the periosteum.

The matter of the survival of a transplanted epiphyseal cartilage cannot be said to have been proven but suggests the value of additional careful experiment.

I wish to extend my thanks to Dr. J. W. Jobling and Dr. D. N. Eisendrath for many helpful sugestions and to Dr. H. G. Wells for looking over the microscopic slides. Also to the internes of Michael Reese Hospital for assistance at the operations.

REFERENCES

1. Barth. Chir. Kong., 1893, ii, 234; 1894, ii, 201.
2. Axhausen. Deutsche Ztschr. f. Chir., 1907, xci, 197.
3. Beattie. Textbook of Pathology, University of Sheffield, 1909.
4. Wieder, H. S. Bull. Univ. Penn., 1909.
5. Janeway. Ann. Surg., Phila., 1910.
6. Murphy. J. Am. M. Ass., 1912, lviii.
7. Streissler. Beitr. z. klin. Chir., 1910, vii, 1.
8. Macewen. The Growth of Bone.
9. Cotton and Lodor. Surg., Gynec. & Obst., 1913, xvi, 701.
10. Haas, S. L. Surg., Gynec. & Obst., 1913, xvii, 137.
11. McWilliams, C. A. J. Am. M. Ass., 1914, lxii, 351.

# THE TRANSPLANTATION OF BONE IN POTT'S DISEASE[1]

## Exhibition of Cases Operated by Albee's Method

By EDWIN W. RYERSON, M. D., Chicago

I HAVE no evidence to bear out any of the various theories which Dr. Lweis has advanced, many of which are familiar to me. It is difficult to believe in view of the experience which I have had in thirty cases of bone transplantation that the bone dies. If it dies, it does remarkably good work after it is dead. It is hard for me to comprehend the actual death of the bone, because in cases of death the bone should lose its function, but in the cases which I am about to discuss the bone does perform the function which we most desire it to perform.

I have in thirty cases resorted to bone transplantation; twenty-eight of these were for Pott's disease, in which the operation of Albee was performed. Albee himself operated in my clinic four of them, at which I assisted, and the other twenty-four were done by me. Two years ago in December, the first three operations of this kind were done in my clinic, and two of the cases done at that time are here to-night.

In November, 1911, this boy had a large sized kyphosis in his upper dorsal region; he was in bad condition; he seemed to be a bad surgical risk. He was growing worse so rapidly, however, that we were glad to accept the risk, and I accordingly performed Albee's operation, January 12, 1912. Two other boys had been operated by me, both in November, 1911, with apparently good results. The technique of the operation is well known, so there is no need to go into it.

In the first three cases I mentioned the bone grafts were cut out with a chisel and mallet, a method vastly inferior to the motor saw. The bone-splint in these first cases was small; it was light; it was bent around the large kyphosis which you see here, and in a couple of months the boy was allowed to be up and about without a plaster jacket because the disease was so high up that the plaster jacket would do him no good. The symptoms of tuberculosis of the spine had disappeared at the time he began to walk around; that is, he no longer had pain; he no longer had disability; he no longer had rigidity of the muscles up and down the spine—the erector muscles. I have not seen him for a long time, and his deformity seems to have increased slightly, but that is partly due to the compensatory curves which have increased below and above the seat of deformity. I cannot distinctly feel the bone splints. We have no X-rays of these two cases.

In my second case, the little boy's kyphosis is slightly evident. This was the apex of it. As he bends, the apex of his kyphos shows up, but he has no difficulty in doing it. He is in good condition and there is every evidence that he is entirely cured. This boy was operated more than two years ago, November 23, 1911. The first boy is thin and pale and weak. His result does not seem to be quite as brilliant as the others. He also has tuberculosis of the hip-joint, which has probably delayed his recovery. The second boy is a remarkably good result. The third case operated on over two years ago seems perfectly well although the size of his kyphos was not diminished by operation.

Case 4. A young lady who was operated after the results of the original three cases were seen to be satisfactory. In December, 1912, that is, about fourteen months ago, she was operated at St. Luke's Hospital during a meeting of the Central States Orthopedic Association.

I had treated her for one year previous to the operation. It was difficult to keep her quiet enough; she was getting worse. She was operated upon a year before at the Michael Reese Hospital by one of the surgeons there for appendicitis. She had recovered from that, and at the time I decided that an operation was necessary she had developed an enormous psoas abscess. The abscess was aspirated at St. Luke's Hospital and a pint of pus removed. Not all of the pus was removed, but all I could readily remove with the aspirator, and two weeks later, the aspiration hole having healed, she was operated by the Albee method. We put in a large splint cut with the motor saw. Here was the apex of the deformity. I made no attempt to remove the projecting spinous process. She has been well since three months after operation, and almost immediately after operation the severe girdle pains disappeared. She has since gained in weight and is apparently perfectly normal. Bending makes the apex of the knuckle rise up a little bit, but the bone-splint, which was at first not securely anchored at the top, has solidified within the last six months. She feels weak without corsets, but seems to be doing very well. The abscess has entirely disappeared.

Case 5. The boy exhibited had a complete paraplegia, so that he was unable to move his legs at all. Six years ago I began to treat this boy for Pott's disease in the orthopedic clinic we had at Rush Medical College. He went from bad to worse; he became extremely emaciated, until he was

[1] Read before the Chicago Surgical Society, March, 1914. (See discussion, p. 615.)

nothing but a skeleton. Then he developed paraplegia and seemed as hopeless a case as I have ever seen. With the consent of the parents we put in a strong Albee splint, scored underneath so it would bend more readily, and within two weeks the paraplegia improved, and within a couple of months he was walking around the ward. He had the same condition of kypohosis that he had when I operated on him. We did not succeed in straightening him, but he has made a gratifying recovery.

CASE 6. The next patient, a boy, was treated for two years at the Children's Memorial Hospital by extension and rest upon a Bradford frame, and he grew worse. Every time we got him up in a plaster jacket he began to go down hill again, and it was at last decided to do the Albee operation. He had a sharp knuckle at the time the operation was done, and I did not succeed in straightening it as much as we have been able to do in some cases. But he has improved rapidly and has gained in weight.

CASE 7. Another boy treated by me for two years for Pott's disease had several sinuses, some on the thigh, and one in the groin. He was operated upon about six or eight months ago and has been running around the wards without apparently any signs of a sensitive spine.

CASE 8. Was operated three months ago, and to-day he had his cast removed. One stitch came out at this point, but otherwise the wound healed uneventfully; the back has become much straighter than it was although the cast was only removed this afternoon.

CASE 9. This case, a girl, had a severe psoas contraction from a psoas abscess, the disease being in the lumbar region. The bone-splint had to be inserted into the two upper sacral spinous processes as well as in the lumbar. The splint did not attach itself firmly at first, and apparently is not set in as deeply as it should be, but it does not separate either at top or bottom as she bends over, and she says that her back feels perfectly strong and well. She was operated on March 17, 1913.

CASE 10. Was a girl who had a large angular deformity which was operated upon the thirteenth of November, 1913. She has a tuberculous left elbow besides the trouble in the spine. The result is very good.

CASE 11. This boy, who was operated last December, seems to have a pretty straight back. He had had a sinus on the side, which has closed, and he seems to be free from symptoms.

CASE 12. Here was a severe case operated by Dr. Albee at my clinic. She was one of the cases treated I think for three or four years with a rapidly progressing deformity, which was more severe at the time operated on than now. Her back has straightened up to some extent. She had a splint put in four or five inches long and she has done remarkably well.

CASE 13. Here is another case which shows a good result. This was a sharp projecting knuckle like the knuckle of a bent forefinger, and it was possible to straighten it up considerably.

A number of these children have been definitely straightened and some have not. We took a series of X-ray pictures of the large girl's back at different times. They show in the negative better than in the print, and demonstrate that the bone-splint is spliced in there solidly, although the union at the upper end is not clearly shown.

These cases, with the exception of the large girl, all came from my clinic at the Home for Destitute Crippled Children, no attempt being made to bring those from the Policlinic and the Children's Memorial Hospital.

In my opinion, Albee's operation is a very important addition to the treatment of Pott's disease. Practically every case can be benefited by it, for a great many of the cases apparently cured by conservative mechanical treatment are later seen to relapse. The operation certainly gives rapid relief to the subjective symptoms in all successful cases, and while we cannot believe that the actual tuberculosis disappears as rapidly as do its symptoms, we can nevertheless be sure that it will disappear more rapidly in those cases where more perfect fixation of the diseased portion of the spine is obtained. The operation of Russell A. Hibbs is essentially as sound in principle as that of Albee, but I have so far had no experience with it.

# BONE TRANSPLANT[1]

By HENRY BASCOM THOMAS, M. D., Chicago
Attending Orthopedic Surgeon, St. Luke's and County Hospitals

FOR many years efforts have been repeatedly made to improve upon the method of mechanical aid which is used in the correction and treatment of certain types of deformity, the predominating inclination being to get support under the skin. Prof. Lange [2] of Munich four years ago at Washington called attention to the classic work of Carrel, who opened the prospect of supplying diseased or lost parts of the body by transplantation of parts of other men. Twelve years ago Lange was hard at work on the problem of tuberculous spondylitis, trying to devise some means of giving support to the spine and relieving the pressure from the vertebral body by means other than recumbency, cast, or visible brace, and in 1910, in an article entitled, "Support for the Spondylitic Spine by Means of Buried Steel Bars Attached to the Vertebræ," [3] made a plea for what he called heteroplastic. He asserted we should further develop it, because we always have inorganic material at hand in any quantity as a substance. At this time he reported a case of tuberculous spondylitis treated with the insertion of two steel wires, tin plated, which were placed along either side of the spinous processes. This idea of a metal support beneath the skin is not indeed successful, but is interesting as the forerunner of the bone support, which must now be regarded as successful.

The development of under-the-skin bone support by Albee in tuberculous spondylitis in New York, and its successful repetition in Chicago and elsewhere, is so gratifying in selected cases of this disease and of fractured vertebræ as to make it a popular treatment growing in favor and tending to replace other methods of operative support for these deformities.

A few of the additional possibilities of the bone transplant are:

1. To plate fractures in long bones, thereby diminishing the possibility of suppuration and of a second operation, in comparison with the Lane plate.

2. To supply congenital deficiency in long bones.

3. To retain corrected or near-corrected position in scoliotic spines.

4. To replace resected tuberculous joints.

5. To hold the over-corrected talipes equino varus foot in position by placing a wedge of bone taken from the tibia in the groove made by the over-correction and in hip pegging, as suggested by Albee.

6. To supply loss of bone following osteomyelitis.

7. To replace joints resected for cyst or malignancy, using strips of tibia taken from the same patient, as in A. E. Halstead's shoulder case, not yet reported. At this time I will consider only cases covered by headings 1 to 4.

1. *Fractures in long bones and bone transplant.* As suggested above, the use of metal in general is unsatisfactory. This method as represented by the Lane plate seems from careful study of the statistics of a number of cases to be used frequently when simple methods should suffice, and when used it is more or less inclined to aid the tendency toward suppuration. In about forty-eight per cent of one series of cases studied there was suppuration or a second operation required to remove the plates. The suppuration is to my mind caused by the Lane plate, and by nothing else. The Lane technique is known to be superlatively careful, and it must, therefore, be the irritation from the Lane plate which causes the trouble. In coming to this conclusion I have had in mind that in my orthopedic services involving a considerable amount of open operative work on the long bones of children and adults, in operations on congenital and rachitic deformities, before and after complete ebonization and on old ununited and malunited fractures, I have had practically no suppura-

[2] Lange, Am. J. Orth. Surg., viii, 345.
[3] Lange, Am. J. Orth. Surg., viii.

[1] Read before the Chicago Surgical Society, March, 1914. (See discussion, p. 645.)

tion. In a series of thirty-four transplants removed from the tibia, some of them ten inches long, there was no infection; there was, however, slight infection in the wound where the transplant was placed in four of the cases. In one of these the trouble was believed to be caused by the heavy silk used to anchor the transplant; one was a stitch abscess which readily healed, and the other two gave evidence of being in the soft tissue, nearer the skin than the transplant. In none of these cases have the transplants been removed or been in such a condition as to indicate removal. A number of very extreme anterior bows of the tibia were openly worked on, often with marked trauma to surrounding parts, and handled with several sets of hands; also wedges of bone and strips of bone were cut away from the crest of the tibia for æsthetic effect only. In none of these cases here referred to, in which there was so much handling of the bone, was a second operation or anæsthetic necessary, as was the case in the series of cases before referred to, in which the Lane plate was placed. The Lane plate, and it alone, makes the Lane technique necessary, and this most careful technique, as shown by the results, seems to indicate the substitution of some other method where possible.

One case presented itself in which I had the opportunity to use a bone-plate precisely as a Lane plate is used. I am not at liberty to report on this case in detail, as it is soon to be published, but I may say that the result was satisfactory, and justifies a careful study of the application of the bone-plate in selected cases of fractures, if plates are necessary, instead of plating with foreign material.

2. *Congenital deficiency in long bones and bone transplant.* Cases having a congenital absence of some part of a long bone lend themselves most favorably to bone transplant, and those where the entire bone is absent should be considered as possible subjects for benefits from this kind of surgery. As illustrative of congenital total absence of a bone, as far as röntgen ray aid gives evidence, is a child two years old, in whom the fifth metacarpal bone of the right hand was absent; the little finger and its phalanges were, however, present. Fair motion in the little finger discouraged its sacrifice by amputation. The possibility of bone transplant was now considered. In a child two and one quarter years old, Rotch,[1] by röntgen ray, shows the os magnum, unciform, lower epiphysis of the radius, cuniform, and semilunar present. The proximal epiphysis of the first phalanx of the little finger is faintly present; distal and proximal epiphyses of the fifth metacarpal are also faintly present. In the case here mentioned, there was total absence at two years of the fifth metacarpal, and no shadow of the distal or proximal epiphysis was present. There was present, however, the proximal epiphysis of the first phalanx of the fifth finger and the unciform bone. There was no attachment for the proposed bone transplant which was intended to replace the fifth metacarpal. The transplant, however, was placed for the following reasons:

(*a*) Although the röntgen ray picture showed no distal and no proximal epiphyses of the fifth metacarpal bone, normally they should be there but would give no shadow at two years of age.

(*b*) If they were congenitally absent, the proximal epiphysis of the first phalanx of the fifth metacarpal and unciform bones which were present were the goals for contacting the ends of the transplant.

(*c*) It was either amputation or a trial at bone transplant. This case was operated a week ago.

3. *Retention of position in scoliotic spines and bone transplants.* The retention of the scoliotic spine in a corrected or over-corrected position is a problem which many who are vexed with the question of the treatment of these cases are concerned. Some think that probably the bone transplant along the spinal column into the spinous processes, as is done for the support of the tuberculous spine, would prove successful. The difficulties which present themselves in this work are:

(*a*) The correction of the curve, in the severe cases, into a position for the transplant. In the mild, flexible cases such satisfactory results are obtained by corrective corsets and exercises that operative fixation is needless.

[1] Rotch, Röntgen Ray in Pediatrics, Plate 31.

(*b*) Even when partially corrected (and this is probably all one may confidently expect in the stiff cases), the spinous processes of the rotated vertebræ are not, as in Pott's cases, lined up evenly, but the entire vertebræ are bent to the side, and each spinous process twisted out of line in such a manner as to make the placing of the transplant between the split surfaces of the posterior spines extremely difficult. Yet animal experimentation encourages more work along this line with hope of better results from operative methods than those obtained by Hoke [1] or Le Breton.[2] The latter made sections of some of the ribs close to the spine, and of a part of the erector spinal group in the apex of the curve, and division of several of the ligaments, but with doubtful results.

4. *Replacing resected tuberculous joints with bone transplant.* Replacement of resected tuberculous joints with bone taken from the patient's tibia often becomes a procedure forced upon the operator with only one alternative, amputation of the limb. Experience shows that in resection of the knee-joint, for instance, the case is often too far advanced, the bone of the femur and of the tibia too extensively destroyed to allow apposition of healthy, firm bone with a fair possibility of ankylosis strong enough to give substantial support. Frequently several inches of both the femur and the tibia must be resected before the tuberculous material is thoroughly cleansed away, and many cases present themselves for treatment so late in the disease that the eradication of tuberculous material without amputation is never accomplished. Stiles [3] found that between 1901 and 1911 in the Royal Edinburgh Hospital for sick children there were sixty-three excisions of the knee in which twelve required subsequent amputation. Without opening up the question of earlier operative interference in selected cases of tuberculous joints, it seems only fair to call attention to the large number of neglected cases complicated with extensive involvement of the para-articular tissue, amalgoid disease, and advanced anæmia, with three possibilities. (*a*) Resection with doubtful results. (*b*) Resection with transplant. (*c*) Death from complications.

The literature gives an account of a case in which Streissler [4] transplanted two sections of bone to take the place of a knee-joint resected for tuberculosis. The case was one in which it was possible to cut away all the affected bone. There seems to be no case reported in which the transplant was placed in tuberculous material. As an example of a knee transplant in which the object was:

(1) To eradicate the disease if possible without amputation, and place the transplant in sound bone; but, (2) if impossible, to clean away all the diseased bone, then to transplant in the diseased bone, attempting to give a stiff leg, strong enough to bear the weight of the body, thus preventing amputation.

I report the following case:

A girl 16 years old, Austrian by birth, had been an invalid for four years, suffering pain and inability to go to work or school on account of a tuberculous left knee. She was a neglected case, and her only chance for comfort and working ability lay in extreme operative interference. E. Wyllys Andrews advised against amputation; he, however, agreed to resection, which was done, removing about three inches of the femur and about two inches of the tibia. The involvement, however, was so extensive that eradication of all the tuberculous material was impossible without amputation. This I refused to do for two reasons. First, the condition of the patient was now not favorable. Second, the prospect for transplanting later was promising for a good stiff leg instead of an artificial one. The wound, therefore, was closed, extension was applied, while a cast was placed to give proper support and maintain extension. This resection gave the patient great relief and her general condition began to improve. Three months after the resection, when her blood had improved, a second operation was performed, transplanting a large piece of the tibia from the opposite leg and implanting it so as to span the space between the tibia and the femur and firmly fixing it to these bones and to the patella.

The technique was as follows:

A longitudinal incision, fourteen inches long, was made in the midline of the anterior surface of the left thigh and leg, above and below the knee. The patellar ligaments were cut at the outer side and below, and the patella pulled to the inner side. The incision was carried down to the surface of the tibia and the femur. Two inches of the upper end of the

[1] Hoke, Tr. Am. Orth. Ass., 1903, xiv.

[2] Le Breton, Am. J. Orth. Surg., 1907, iv, 315.

[3] Stiles, Harold S. After-Results of Major Operations for Tuberculous Disease of Joints. Brit. M. J., 1912, 1364.

[4] Streissler. (Beitr. z. klin. Chir., 1910, lxxi, 1.)

tibia were sawed off, leaving a fairly healthy tibial surface. A wedge-shaped piece of the anterior surface of the tibia, one inch long, was now chiseled out to permit the graft, ten inches long, taken from the right tibia, to fit in and lock. A wedge-shaped piece of the lower end of the femur was also removed and some newly-formed bony tissue chiseled out to receive the upper end of the graft, but the bone here was soft, tuberculous, and unpromising for a transplant bed. Transverse drill holes were now made in one side of the lower end of the femur, in the upper end of the tibia, and through the ends of the graft to correspond. The bone graft was now fitted in place between the femur and the tibia and fixed by kangaroo tendon through the drill holes made in the femur, patella, and the tibia. All periosteum which was saved was sutured about the bone. The muscles were sutured together over the graft with catgut and the wound closed with silkworm sutures and dressed with dry gauze, pads, and sterile bandage. A plaster of Paris cast was now applied from the thigh to the toes.

For the removal of the transplant from the tibia a longitudinal incision was made over the crest of the right tibia, twelve inches long, down to the bone. For this part of the operation a fresh set of instruments was used. The muscles were separated from the bone at its outer surface and a triangular graft from the crest of the tibia, ten inches long, was removed with its periosteum and the muscles were pulled over the denuded bone with catgut sutures, and the wound closed with silkworm. A plaster of Paris cast was applied from the knee down, enclosing the foot.

The progress of this case since the transplant was placed has been satisfactory. The patient improved in general condition. The wound healed by first intention, but later gave evidence of a slight discharge of serum, containing a few polymorphyler leucocytes and some scattered cocci. This soon cleared up and both wounds are closed and look resistant and healthy. The patient is up and about with crutches, forbidden, however, to bear weight on the leg. Röntgen ray pictures show the bed in the right tibia from which the transplant was taken is fast filling in, as is the case in a series of twenty-seven legs from which large grafts were taken for tuberculous spines, as reported in a paper entitled, "Spinal Transplant," read last month before the Chicago Medical Society.

The pictures of the transplant, placed with its upper end in the remains of a tuberculous femur, one side of which was too soft to hold a drill hole, and the lower end also lying in tuberculous material, show regeneration of bone taking place, with the lower end of the transplant well interlocked with the tibia and the upper end in good condition but somewhat atrophied. This bone support looks better at this time, six months after the operation, than I had anticipated, in view of the decayed condition of the femur at the time of the operation.

An interpretation by Adolph Hartung, of the röntgen ray lantern slide, is as follows:

"The anteroposterior view of the plate shows an absent area about the knee joint at the lower portion of the femur and the upper part of the tibia. Extending between the ends of these two bones and into their medullary canal for a distance of about one inch is a splint having the consistency of solid bone and tapering somewhat at its upper end. Around this upper end some rarefaction has occurred in the femur, uniform on its outer but irregular on its inner aspect. Well defined calcareous deposits extend from the margins of the resected femur and tibia. Along the lower end of the splint they seem to encircle it fairly uniformly up to the head of the fibula. The fibula is entirely intact and normal in appearance. The patella is indistinctly outlined and apparently covered by overlying shadows of calcareous material, of which there is a good deal to be seen throughout the joint area.

"The lateral view shows much the same picture except that here the patella seems intact and directly in contact with the bone splint. The upper end of the splint is very near the anterior aspect of the femur. Considerable calcareous deposit is seen behind the splint and also around its lower end."

# SUPERNUMERARY URETER OPENING EXTRAVESICALLY

By HENRY DAWSON FURNISS, M. D., F. A. C. S., New York City

SUPERNUMERARY ureters emptying into the bladder are often seen, but a supernumerary ureter opening extravesically is a rarity, and because of this, its clinical importance, and the fact that there is generally a failure to properly diagnose the condition, I report my case.

N. M., a girl of twenty years, referred by Dr. A. R. Stern. Her menstrual history was negative, and she had never been pregnant. As long as she can remember she had been wet with urine, day and night, and yet voids normally once or twice a day. Neither exertion nor rest has any effect upon this condition. The patient is well formed, shows no stigmata of degeneration, nor abnormalities of the genital organs.

The condition was suspected from her history, which was characteristic; i. e., constant discharge of urine since birth in addition to normal voiding.

The examination was made with the idea of finding an abnormally opening ureter and was conducted as follows:

Ten ccm. of three-tenths of one per cent solution of indigo-carmin was injected intravenously and the patient then cystoscoped. A normally situated ureter excreting urine in a normal manner was found on either side; no vesical lesions nor malformations were noted in the external orifice of the urethra. The whole urethra (with the Kelly speculum) and the entire vagina, with the patient in the knee-breast posture, was then inspected without discovering the source of the leakage.

Still being convinced that the condition was as at first suspected, I plugged the vagina with wet cotton tampons, put wet cotton applicators in the urethra extending just to the vesical sphincter of the urethra, and a pledget of wet cotton over the vestibule of the vagina. After waiting fifteen minutes these were removed, and it was found that the cotton over the urethral orifice was stained faintly blue while the ones from the urethra and vagina showed no discoloration.

Close inspection failed to show the ureter until the patient strained in moving, when there was a discharge of a few drops of fluid from a minute orifice in the median line just at the lower edge of the urethral opening. A No. 6 ureteral catheter could be introduced only two inches, running slightly to the left. From this was obtained in ten minutes 3ii of a faintly bluish colored fluid of a low specific gravity. The specific gravity was not taken, nor was an estimate of the urea percentage made.

It would have been interesting to have injected all three ureters with collargol and to have radiographed the patient to see their relations to each other and to the kidney pelves, but this was abstained from, as it would have been of no benefit to the patient, and we ran the danger of causing infection, ureters opening extravesically being especially susceptible.

*Operation.* On June 28, 1913, in the Post-Graduate Hospital, under ether anæsthesia, the supernumerary ureter was catheterized for four inches with a ureteral catheter. Using this as a guide, an incision was made over it on the under surface of the urethra, but unfortunately the incision went into the ureter itself, which was thin-walled and dilated to the size of a large lead pencil. This dilatation involved only the distal one inch of the ureter. Thinking that the whole ureter would possibly be dilated, and that I would have great difficulty in dissecting it out, I then put through the urethra a uterine sound which was made to bulge the bladder just over this ureteral sac. An opening between this sac and the bladder was made, and the mucosa of the ureteral sac and the mucosa of the bladder sutured together. Next the floor of the ureteral sac and the external orifice of the ureter were closed with fine catgut, thus producing a fistula between the bladder and the ureteral sac into which the ureter emptied.

The vagina was closed over this with sutures of silkworm gut. A retention catheter was put into the bladder, and removed on the fourth day; up to this time there had been no leakage, but following the removal of the catheter, the patient had the same leakage as before the operation.

Because of this failure the patient was operated upon again on July 11th. The silkworm gut sutures were removed and it was found that the leakage occurred from the posterior end of the incision. To gain better access to the ureter a pararectal incision was made through the left sulcus of the vagina; a catheter was then passed into the ureter and the ureter dissected out for an inch and a half. I was surprised to find how easily this was done and to see how thick the ureter really was, being here the size of a goose quill. A uterine sound was then passed through the urethra and made to bulge the bladder just behind and to the inner side of the normal opening of the left ureter. A small incision was made on the point of the sound which was then pushed into the vagina. A suture was passed through one lip of the ureter, tied to the sound, and in this way the ureter was pulled into the bladder for a distance of three quarters of an inch. This suture was withdrawn through the urethra and with a needle was anchored just outside of the clitoris. One fine suture of plain catgut was passed through a portion of the muscular wall of the ureter and the opening into the bladder, and the vagina closed over this with interrupted sutures of catgut. A retention catheter was put into the bladder for four days.

Following this operation there was not a bit of leakage, but the patient experienced frequent and painful urination due to a rather severe cystitis, which lasted ten days, but was cleared up by irrigations with nitrate of silver solution.

Two days following the second operation the patient had a rise of temperature and pain in the region of the left kidney. The temperature quickly subsided, but since then there has been more or less pain in the renal region.

An examination on August 1st with the cystoscope shows the ureter that was implanted as a small round opening just behind, and to the inner side of, the normal ureter. I have been unable to catheterize this on account of its minuteness; and after an intravenous injection of indigo-carmin I have seen no elimination of the dye from it. There seems to be a periodical discharge of small amounts of clear fluid, though of this I am not certain.

In most of the reported cases, as in mine, the following conditions were noted:

Minute orifices: In ureters opening just below the urethra this has been described by all except Olshausen as a very minute round orifice, and generally the location has been just on the margin of the external orifice of the urethra.

In Olshausen's case this orifice was described as "slit-formed." These orifices are very difficult to discover, even when directly under the eye, and are best seen after giving the patient methylene-blue or indigo-carmin to render the urine blue.

*Sac formation;* In most of the cases this has been noted just back of the contracted orifice, but this as a rule involves only the terminal portion of the ureter. The difficulty in catheterization is due to the trouble in making the catheter enter the ureter at the kidney end of the sac.

*Impaired function;* This is most probably due to the back pressure atrophy caused by the contracted orifice of the ureter. This has been noted in most of the cases as evidenced by the light color, low specific gravity of urine with small urea content, and deficient elimination of phenolsulphonephthalein and indigo-carmin.

*Tendency to Complications;* This is noted in many cases of supernumerary ureter, and when they open extravesically it is increased. Infection after instrumentation because of the poor drainage due to the contracted orifice is the most usual complication. Cessation of function was apparent in my case, but not noted in those reported by the authorities mentioned below. This cessation probably came from the contraction of the vesical orifice of the ureter.

*Diagnosis.* From the history of incontinence since birth with normal voiding of urine, an abnormal opening of the ureter should be suspected.

If by inspection the orifice of the ureter is not seen, indigo-carmin, methylene-blue or phenolsulphonephthalein should be given, and the vagina and vulva packed with cotton. If phenolsulphonephthalein is used the cotton should be wet with an alkaline solution to bring out the color; after fifteen to twenty

minutes the cotton is removed and the stained portion will give a clue to the point of the opening of the ureter.

Cystoscopy will show whether the extravesical ureter is supernumerary, or the only one from the kidney.

Many operations have been proposed for this condition, such as ligation of the ureter, establishment of a fistula between the sac-like portion of the ureter and bladder, implantation of the ureter into the bladder either through the vagina or abdominally, both intra- and extra-peritoneally, partial nephrectomy, removing the portion of the kidney drained by the supernumerary ureter.

From a study of my case and those reported in the literature, I believe the vaginal implantation the procedure of choice.

To determine just how this should be best done, I shall in the future attempt to catheterize the two ureters on the side affected with different kinds of X-ray bougies and have stereoradiographs made. By determining the relation of one to the other, the operation can be so planned that they will not be twisted around each other.

For those desiring to review the literature of the subject, I refer them to:

Adrian & A. V. Lichtenberg, Ztschr. f. Urol. Chir., 1913, i, Nos. 2 and 3. Die Klinische Bedeutung der Missbildungen der Niere, des Nierenbeckens und Harleiters.

Joh. Hartman[1] of Leipzig, reports from the literature:

Sixteen certain cases of supernumerary extravesical ureters, twelve uncertain cases of supernumerary extravesical ureters and seven cases of single ureter opening extravesically.

J. P. Hartman, of Copenhagen,[2] reports nineteen cases of supernumerary ureters opening extravesically, operated upon by various surgeons after the following methods:

| | No. | Successful | Unsuccessful |
|---|---|---|---|
| Ligation | 1 | 0 | 1 |
| Ureterocystotomy | | | |
| Intravesical | 2 | 2 | 0 |
| Vaginal | 5 | 0 | 5 |
| Implantation | | | |
| Laparotomy | 3 | 2 | 1 |
| Abdominal extraperitoneal | 1 | 1 | 0 |
| Vaginal | 6 | 4 | 2 |
| Resection of Kidney | 1 | 1 | 0 |
| | 19 | 10 | 9 |

He also gives the following analysis of thirty-seven cases of ureter opening extravesically, fourteen of which are supernumerary ureters:

| Opening in the | No. | Single ureter | Supernumerary |
|---|---|---|---|
| Urethra | 6 | 3 | 3 |
| Vagina | 8 | 5 | 3 |
| Vestibule | 21 | 11 | 8 (2?) |
| Gartner's Duct | 2 | ? | ? |

[1] Ztschr. f. Urol., 1913, vii. 429, Zur Casuistick und Operative Behandlung überzalige aberanter Ureteren.

[2] Ztschr. f. Gynäk. Urol., 1912, iv, 69.

# THE INFLUENCE OF ECTOPIC PREGNANCY ON THE UTERUS, WITH SPECIAL REFERENCE TO CHANGES IN ITS BLOOD SUPPLY AND UTERINE BLEEDING[1]

BASED ON THE STUDY OF 25 INJECTED UTERI ASSOCIATED WITH ECTOPIC PREGNANCY

BY JOHN A. SAMPSON, M. D., ALBANY, N. Y.

THE purpose of the present article is to show the influence of ectopic pregnancy on the uterus, with special reference to the changes in its blood supply and the etiology of the uterine bleeding due to this condition. The latter is an important symptom, which is usually present in these cases when the physician is first called to see the patient.

The material for this study consisted of twenty-five uteri associated with ectopic pregnancy which were removed at operation, and as a matter of routine injected soon afterwards.

Dr. Richard R. Smith, in 1911, presented before the American Gynecological Society a paper entitled "Repeated Ectopic Pregnancy, with a Report of Four Cases and a Statistical Review of the Literature."[2] He concludes that "normal pregnancies following ectopic pregnancy are not as frequent as one might hopefully suggest, and that the practical lesson to be drawn from this discussion of repeated ectopics relates to the disposition of the opposite tube at the time of the operation. The strong tendency of the last decade toward conservation of the pelvic organs has resulted in the saving of the opposite tube with most surgeons unless it is diseased. Is this conservation based on logical grounds? It is my opinion that we must modify it. The common basis for decision has been the condition of the tube under judgment, and a little thought will show this to be unreliable. In very many of the reports in which its condition is mentioned it is spoken of as normal. It must be frankly acknowledged that we are unable to judge of the capabilities of a tube from its appearance. Shall we not rather consider the woman's condition relative to age, previous child bearings, her health, her wishes, and the danger lurking in the tube that is left, whatever its appearance. I would suggest that the matter of future possibilities be freely discussed, so far as practicable, with each patient before the abdomen is opened, and would suggest the following outline of procedure:

"1. If a woman has had no children and is young, or, being older, is desirous of having children, we should conserve the opposite tube unless it is hopelessly closed. We do this deliberately, with the full knowledge that further pregnancies may not occur and that she may have, in spite of the normal appearance of the tube, a further ectopic.

"2. In women who have borne children, we may be governed by her desire to have more, and may leave it unless it is absolutely closed.

"3. In women who have had children and have borne as many as they desire, we should unhesitatingly remove the opposite tube and preclude the possibility of further accident, whether the tube appears normal or not.

"By following this course we should at least have a good excuse for submitting a woman to the distressing possibility of a second ectopic pregnancy."

For the last four years I have been following a procedure similar to the one outlined by Smith, and my own experience has justified this procedure. Previous to 1905 I had operated upon eleven cases of ectopic pregnancy in the service of Dr. Howard A. Kelly, of Baltimore, and know nothing of the future of these cases, but in only five was a subsequent pregnancy possible, both tubes or the uterus and tubes having been removed in the other six.

Since coming to Albany, in 1905, I have operated upon forty cases of ectopic preg-

[2] Tr. Am. Gynec. Soc., 1911, xxxvi.

[1] Read before the American Gynecological Society, May, 1913.

nancy. In only eleven was a future pregnancy possible, the uterus having been removed in twenty-six, and future conception made impossible by the removal of both tubes in one, the only remaining tube in another, and one having died soon after the operation. The subsequent history of these eleven patients is of interest, especially as the opposite tube was carefully examined in nine of them and was apparently normal; and was saved with the hope of subsequent uterine pregnancy. In two the condition of the patients was so grave at the time of the operation that the opposite tube was not examined. Five of the eleven patients have not conceived since the operation (less than six months has elapsed since the operation in two of them). Of the other six patients two have borne children; one has had two children since her operation, and another has had one; the latter has subsequently had a tubal pregnancy in the remaining tube. Three have had miscarriages, one has had four, and two have had one each. The sixth has had a tubal pregnancy in the opposite tube. Therefore, two of the six have had a tubal pregnancy in the opposite tube; one, as already stated, was preceded by a uterine pregnancy. In addition I have encountered two other cases of tubal pregnancy in which the opposite tube had been removed for a similar condition by another surgeon.

My own experience conclusively proves that when we do not remove the opposite tube, even though it appears normal, when operating for tubal pregnancy, the patient may subsequently have a pregnancy in that tube.

In spite of the dangers of repeated ectopic pregnancy, I believe that the chance of subsequent pregnancy should, if possible, be preserved in women who are desirous of having children or should have them irrespective of their own wishes. While the discussion of future possibilities with patients before operating has certain drawbacks, it also has certain advantages, and I believe the latter outweigh the former. It is true that the patient may live in fear of a subsequent tubal pregnancy and at times become very apprehensive. There is the decided advantage, however, that if it does take place the patient immediately consults a physician and, in fact, may herself make the correct diagnosis, as occurred in two of the four cases of repeated tubal pregnancy I have seen. But why remove the uterus? I do not consider that it is usually good surgical judgment to remove both tubes and leave the uterus in a patient who may previously have had a pelvic infection or may have pelvic adhesions after the operation. The possibilities of trouble subsequent to a hysterectomy are less than after a bilateral salpingectomy, and the added danger in nine-tenths of the cases is not appreciable. There was only one operative mortality in the fifty-one cases and that followed a unilateral salpingo-oöphorectomy.

Methods of preserving and studying the material.—The injection mass used was fifteen per cent gelatin, which contained in suspension either a pigment or some material (usually bismuth subcarbonate) which is impervious to the X-ray. The methods of injecting, preserving, and studying the specimens were similar to those described in my paper "The Blood Supply of Uterine Myomata."[1]

Photographs were made of cross or sagittal sections of the more interesting uteri where pigment was used in the injection mass and radiographs were made of cross "slices" of the uteri injected with bismuth. The contents of all the tubes, the seat of an ectopic pregnancy, were examined microscopically. From three to six "blocks" were taken from different parts of the uterine wall, including the mucosa, and examined microscopically in order to ascertain the exact condition of the myometrium and endometrium in different parts of the uterus, and microphotographs were made of many of these.

The pregnancy in all the twenty-five cases was situated in the tube, the right tube being involved in nineteen and the left in six. Only one was of the interstitial variety. Ten definitely arose in the ampulla of the tube and four in the isthmus. In the remaining ten it was difficult to determine the exact part of the tube in which the pregnancy first developed, on account of the general distention of the greater portion of the tube. From their

[1] Surg., Gynec. & Obst., 1912, xiv, 215.

appearance it would seem that in the majority, if not in all of these ten, the pregnancy first developed in the ampulla. Tubal abortion was present in sixteen and rupture in eight, and in one (the one arising in the interstitial portion of the tube) the cornu of the uterus was about to rupture.

I regret that I am unable to present a complete study of this problem, as all the stages of ectopic pregnancy were not encountered in this series, and some of the most important ones were absent. In all of my cases the termination of the pregnancy had begun before I saw the patient, and the shortest time that had elapsed, from the onset of these symptoms until the day of the operation, was three days, and the largest fœtus found was only 6 cm. long.

All of the uteri in this series were studied with a knowledge of the clinical history of the case (not complete in every case).

The most important data in studying the influence of ectopic pregnancy on the uterus are: first, the age of the ectopic gestation when the termination of the pregnancy began; second, the time that had elapsed from the onset of the termination of the pregnancy until the operation, and, if completely terminated, the date of the last severe attack of pain; third, the condition found within the pregnant tube, and especially whether the products of conception were still present or not, and, if present, what they were; fourth, whether or not uterine bleeding had been present, and especially, if present the day of the operation. Other data are of interest, such as the age of the patient, her menstrual and marital history, the situation of the ectopic pregnancy, and the method of termination (whether by tubal abortion or rupture) and associated conditions, but all these are of secondary importance to those just mentioned.

The age of the ectopic gestation is difficult to determine even when the embryo or fœtus is found if several days have elapsed since the beginning termination of the pregnancy, because its growth might cease at that time, or it may even become smaller (some are apparently entirely absorbed), or if it continued to grow its rate would probably be retarded. The menstrual history is often of very little value in deciding this point, as in many instances the patient had not missed her menstrual period. The size of the tube may be misleading as an index of the age of gestation, as it depends upon several factors, the most influential of which is the amount of hæmorrhage into the lumen of the tube and the ease with which it escaped into the peritoneal cavity. There was not any evidence, in this series, of the blood in the tube escaping into the uterine cavity. I have attempted to determine the age of ectopic pregnancy from all the available factors in each case, relying for the most part on the conditions found within the tube. The embryo or fœtus was found in six cases, and five of these were still within the tube. The length of five of these was as follows: 3 mm., 4 mm., 1.2 cm., 4 cm., and 6 cm.; the sixth was 2.6 mm. in cross section (accidental finding in a stained section). The gestation sac was found in the tube in five other instances without any evidence of the embryo in the tube, the latter having been absorbed or expelled. The greatest diameter of each of these five sacs was as follows: 1 cm., 1.4 cm., 1.5 cm., 1.8 cm., and 2 cm. In ten specimens chorionic villi were found, but the embryo or gestation sac was not seen; in the four remaining cases no trace of the ectopic pregnancy was found other than the clotted blood. The five gestation sacs without embryos, the largest of which had a diameter of only 2 cm., and the three smallest embryos found in sacs having diameters of 1.2, 2, and 3.5 cm., have led me to believe that the termination of the tubal pregnancy in these eight cases probably began within the first month, and I believe that the majority of the others also terminated early, the most advanced pregnancy containing a fœtus only 6 cm. long.

The time that had elapsed since the onset of the termination of the pregnancy is based on the date of the first attack of pain, which is usually preceded by, associated with, or soon followed by uterine bleeding. Both symptoms were present in all but one of these cases, and in the majority of them more or less constantly until the operation. One

would expect that the condition of the uterus would change with the length of this time, and this was found to be true. Only two of the patients were operated upon within the first week of their acute illness, three between one and two weeks, three between two and four weeks, fourteen between four and eight weeks, and three after eight weeks. The longest time that had elapsed since the onset of symptoms suggesting the beginning termination of the pregnancy (pain and uterine bleeding) was seventy-two days; this patient was confined to her bed the greater part of this time, and uterine bleeding continued more or less constantly throughout the time and was present the day of the operation. The termination of the pregnancy in this instance was incomplete, a gestation sac 3.5 cm. in its longest diameter was still in the tube, and what appeared to be the remains of the embryo, 4 mm. long, within this sac.

In the case of the interstitial pregnancy the cornu of the uterus was about to rupture (see Case 25), and the gestation sac was still present, surrounded by blood, but no trace of the embryo was found. In twenty-one of the twenty-five cases of tubal pregnancy, as already stated, some of the products of conception were found within the tube. In these twenty-one cases the termination of the tubal pregnancy was *incomplete* in the fullest sense, although four weeks or more had elapsed in seventeen of them since the termination began and over eight weeks in three. In four cases no trace of the embryo or gestation sac were found within the tube. One of these had terminated by tubal abortion, and in the manipulation of the tube at the time of the operation a bloody mass was expressed from the fimbriated end of the tube, which was lost. In the remaining three the pregnancy had terminated by rupture and the tube was badly torn. Still in these three the apparent completion of the termination of the pregnancy may have been accomplished by the manipulation of the tube at the time of the operation, and, furthermore, the fact that chorionic villi were not found does not prove that they were not there, for the entire tube was not examined microscopically. My own studies (based on only twenty-five cases) have led me to believe that the *termination of the pregnancy is rarely complete* in the full sense of the term when the patient is operated upon, and as long as it is incomplete attacks of pain and uterine bleeding may occur.

Twenty-four of the twenty-five patients gave a history of uterine bleeding, usually inconstant and associated with attacks of pain. The only one which did not give a history of uterine bleeding showed intact decidua formation of the endometrium and a fœtus 6 cm. long in a tube with a small opening in its upper surface through which chorionic villi protruded. In some the uterine bleeding preceded the pain and in others a severe attack of pain was the first indication of the beginning termination of the pregnancy. The exact relation between the two was not ascertained in all the cases. In all but three of the specimens some of the venous injection mass escaped from the endometrium into the uterine cavity and out the cervix when the specimen was injected, and in no instance did any of the arterial mass escape. *The uterine bleeding in all these cases was of venous origin and arose from the endometrium, and in not a single instance did it escape from the tube into the uterine cavity.*

The associated tubal and ovarian conditions presented some unusual features. In one instance the pregnant tube communicated with the sigmoid through the fimbriated extremity, and, aside from pain, attacks of bleeding from the rectum was the most marked symptom the patient had (see Case 23). In another case a necrotic parovarian cyst, 13 cm. in diameter, with a twisted pedicle, was present in the opposite ovary (see Case 4). Retention cysts of the ovary were present in six instances, in two cases bilateral. I do not understand the significance of their occurrence. The definite results of previous pelvic inflammation were encountered in nine, a tubo-ovarian abscess once, a pyosalpinx once, hydrosalpinx once, bilateral tubal tuberculosis once, and in the remaining five old adhesions about the opposite tube and ovary. In eight instances the opposite tube and ovary appeared normal.

### THE BLOOD SUPPLY OF THE NON-PREGNANT UTERUS

I have already described certain features of this in two previous articles.[1] In connection with the study of the present subject, I wish to again briefly describe the blood supply of the uterus with special attention to that of the endometrium, concerning which I have learned more since writing the previous articles.

The course of each uterine artery along the side of the uterus and its free anastomosis with the ovarian of the same side are well known. From each uterine artery branches arise, at intervals, which penetrate the uterus. These branches, which I have called arcuate arteries, pass between the outer and middle third of the anterior or posterior uterine wall, and each one supplies a quadrantal segment of the uterus, corresponding to a segment of either the anterior or posterior half of the Müllerian duct of that side. They terminate in median (peripheral) and radial (centripetal) branches. The peripheral terminal branches of some of the arcuate arteries of one side anastomose freely with similar branches of the corresponding arcuate arteries of the opposite side, thus establishing a free arterial communication between the two uterine arteries. Along the course of each arcuate artery peripheral (centrifugal) and radial (centripetal) branches arise. The peripheral branches nourish the peripheral portion of the myometrium, and the latter the remainder of the myometrium and the endometrium. The arterial system of the uterus enables us to divide the uterus into three zones: first, the peripheral (the outer third), which is nourished by peripheral arteries; second, the arcuate, the narrow (boundary) zone in which the arcuate vessels lie, and, third, the radial (the inner two-thirds, including the endometrium), which is nourished by radial arteries.

All the intrinsic uterine arteries pursue a spiral course, which is apparently a provision for the changes in size of the uterus and uterine contractions. There are free anastomoses between some of the branches of the peripheral arteries. On the other hand the terminal branches of the radial arteries appear to be end arteries. When an arterial injection mass was used of sufficient coarseness so that it would not escape into the veins, I found that while the radial arteries terminated in the endometrium this tissue appeared to be poorly supplied with arterial blood, as vessels containing the injection mass extended into it for only a short distance. On the other hand the examination of the endometrium with the higher powers of the microscope showed that arterioles with lumina too small to receive the injected mass were present. These arterioles or large capillaries seemed most abundant in specimens obtained during the premenstrual stage of the menstrual cycle and extended to the compact layer and tissues beneath the epithelium lining the uterine cavity. (See description of the uterus in early uterine and ectopic pregnancy.) In many specimens these arterioles were apparently very few in number or difficult to detect, and this seemed to be particularly true of patients operated upon in the post-menstrual and interval stages of the menstrual cycle.

The venous system is as follows: first, a rich plexus of the endometrium which is fed by the terminal branches of the radial arteries; second, a similar but larger plexus of the myometrium which communicates with that of the endometrium by venous channels. About the periphery of the myometrium, especially on the sides and sometimes accompanying the arcuate arteries, are collecting veins which convey the venous blood to the uterine veins between the layers of the broad ligament.

The arteries of the myometrium have distinct walls, and these become physiologically sclerotic as the individual becomes older, and furthermore there is a temporary thickening of some and destruction of others in the process of involution following childbirth. When studying the arteries of the myometrium we must not only know the age of the patient, but if she has not yet reached the menopause whether or not she has had children, and if she has, the date of the last childbirth.

The veins, except the collecting veins of the myometrium, are for the most part lacking in

[1] The Blood Supply of Uterine Myomata, Surg., Gynec. & Obst., 1912, xiv, 215, and The Influence of Myomata on the Blood Supply of the Uterus, Surg., Gynec. & Obst., 1913, xvi, 144.

distinct walls, *i. e.*, there are merely spaces lined by endothelial cells between the bands of muscle fibers.

The arteries in the base of the endometrium have distinct walls, and the fine arterioles with lumina so small that they cannot be injected with bismuth or other granular pigments, also have distinct walls, and they pursue a spiral course, as the arteries in the myometrium. On the other hand the venous plexus of the endometrium, as in the myometrium, is composed of spaces in the stroma, lined by endothelial cells. As there are not any valves in the uterine veins, the muscular efficiency of the uterus must play an important part in regulating the amount of blood in these spaces and the control of the same.

Just before the menstrual flow the endometrium is thickened and the glands are hypertrophied, and there is often a distinct compact layer which may resemble the decidua of early uterine pregnancy. In addition the arterioles are more evident and apparently more numerous. The venous spaces are also dilated. Following the menstrual flow the endometrium becomes thinner, the compact layer is less evident, the glands are smaller, and the arterioles are more difficult to detect and apparently fewer in number and smaller.

The premenstrual stage suggests the arterial invasion of the endometrium with the evidence of increased functional activity, as in early pregnancy. Menstruation, on the other hand, suggests "labor" and apparently is followed by a process of involution which differs in degree from the involution following the birth of a child, and one of its most important features is a diminished arterial supply, and this is possibly an early step in the process of its involution.

### THE BLOOD SUPPLY OF THE UTERUS OF EARLY PREGNANCY

The uterus is increased in size, and this is due to several factors: first, the pregnancy within the cavity; second, arterial and venous hyperæmia, and, third, the muscle fibers are probably larger.

As the present study of the changes of the uterus in early uterine pregnancy was undertaken for comparing it with the changes in ectopic pregnancy, the description of the changes in the endometrium will be confined to the decidua vera.

The decidua vera resembles the endometrium of the premenstrual stage of the menstrual cycle, except it is further developed, and this is apparently due in a large measure to its increased arterial supply. Sometimes it is very difficult to distinguish between the premenstrual endometrium and the decidua vera of early uterine pregnancy, especially as in very early pregnancy typical decidual cells are absent.

The endometrium of early pregnancy (Figs. 6 and 7) is thickened and may be divided into a compact and a glandular or spongy layer. The compact layer contains many arterial capillaries, about which the decidual cells apparently first develop. Venous spaces are also present in the compact layer, and especially at its junction with the spongy layer. The spongy layer owes its appearance to the hypertrophied uterine glands, and in places there is very little stroma between the glands. On the other hand trabeculæ are found scattered through the spongy layer, which unite the compact layer with the myometrium. These trabeculæ consist of stroma and contain the terminal branches of the radial arteries whose arterioles are found in the compact layer. The arterial trabeculæ, as I have called them, are much more distinct, and their arteries are much larger than in the non-pregnant condition. The arterial injection mass, which in the non-pregnant condition usually extends only a short distance in the endometrium, is quite frequently found in the arterioles of the compact layer of the pregnant uterus. The arteries pursue a spiral course in the trabeculæ, so that a longitudinal section gives the appearance of several vessels instead of one. There is often a decidual reaction of the stroma about the arteries in the trabeculæ. The development of the compact layer with its increased arterial supply and the presence of the arterial trabeculæ uniting the compact layer with the myometrium suggests that the changes in the decidua vera due to pregnancy are in a large measure dependent upon the invasion of its

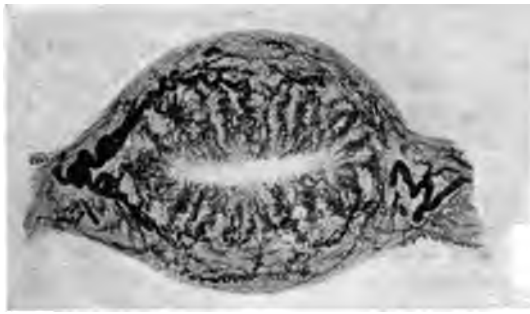


Fig. 1. Arterial supply of the uterine tissues. Radiograph (X 1) of a cross slice (3 mm. thick) of the body of the uterus. Nullipara, aged 34; arteries injected with bismuth; uterus removed for chronic pelvic peritonitis. For detailed description of the arterial supply of the uterus, see text. The radial arteries, *i. e.*, the centripetal branches of the arcuate arteries, are distinct, and the radiograph does not suggest any arterial sclerosis. Compare with Fig. 29.

Fig. 2. Venous supply of the uterine tissues. Radiograph (X 1) of a cross slice of the body of the uterus, as in Fig. 1. Nullipara, aged 30; veins injected with bismuth through the uterine and ovarian veins. Uterus removed for chronic pelvic peritonitis in the latter part of the interval stage of the menstrual cycle.

For detailed description of the venous supply, see text. There is a rich venous plexus in the endometrium and the myometrium, and as there are not any valves in these plexuses, an intact endometrium and a tonic condition of the uterine muscle are important factors in preventing bleeding into the uterine cavity.

tissues by arteries through these trabeculæ. Venous spaces are found everywhere in the endometrium in the compact layer and the junction of the two layers, as well as in the arterial trabeculæ and the stroma between the glands.

### THE INVOLUTION OF THE UTERUS AFTER ABORTION

Bearing in mind the structure of the decidua vera of early pregnancy with its compact and loose spongy layer, the trabeculæ containing spiral arteries which cross the latter and terminate in the former, and the venous spaces, especially those in the peripheral portion of the compact layer and at the junction of the latter with the spongy layer, we would expect that the violent contractions of labor (abortion) would impair the arterial supply of the compact layer and otherwise damage the structure of the decidua vera, especially at the junction of the two layers. We would expect this damage would lead to an extravasation of blood from the venous spaces, and the ones most readily injured would be those in the superficial portion of the compact layer and at the junction of the two layers. As a result of abortion the gestation sac, together with the embryo or fœtus, are expelled. If the abortion is complete, *i. e.*, all the products of conception are expelled, the uterus undergoes involution, *i. e.*, it becomes smaller, and the bleeding soon ceases. The involutionary changes in the decidua vera of early pregnancy are apparently similar to those following menstruation.

In a specimen from a young woman nineteen years old, whose uterus was removed for pelvic inflammatory conditions eight weeks after an abortion at the third month (her first pregnancy), I found that many of the radial arteries and their branches were markedly thickened and some of the branches were completely thrombosed. The latter changes were most evident in the branches just beneath the endometrium. The changes in the radial arteries, and especially in the branches supplying the endometrium, led me to believe that these are an important factor in the process of the involution of the endometrium.

If the abortion is incomplete, *i. e.*, some of the products of conception are still retained in the uterus, the uterus remains enlarged, uterine bleeding often occurs, and we speak of the condition as one of subinvolution, which is clinically relieved by the complete removal of the products of conception. It is interesting to note, as will be shown later, that the same

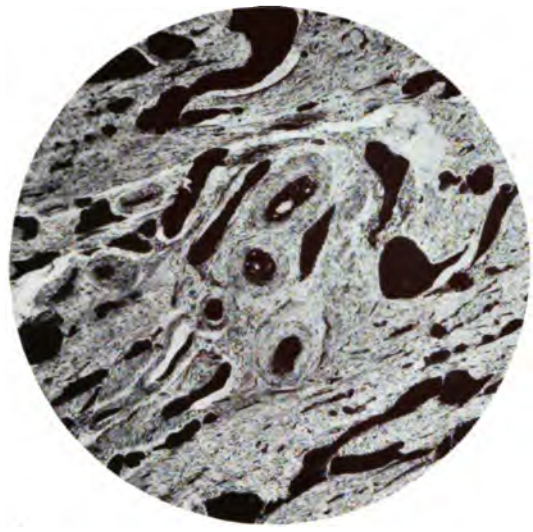


Fig. 3. The difference in the structure of the arteries and the veins of the myometrium. Photomicrograph (X 20) of a portion of the uterine wall. Arteries injected with Venetian red and veins with bismuth, both injection masses appear black in the photomicrograph. The arteries, easily detected, have distinct walls, while the veins (venous plexus) consist of spaces lined by endothelial cells between the bundles of uterine muscles. Distinct venous walls are apparently present only in the collecting veins, none present in this illustration.

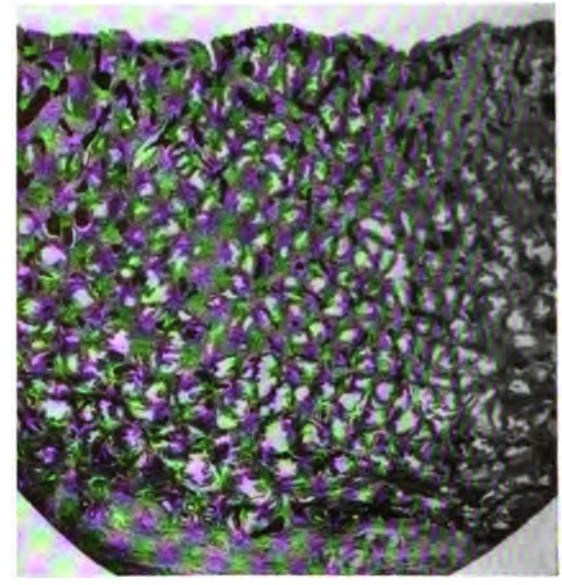


Fig. 4. Structure of the endometrium in the latter part of the interval stage of the menstrual cycle. Photomicrograph (X 20) of a portion of the endometrium from the specimen shown in Fig. 2. The endometrium is thickened; glandular hyperplasia is present with an overlying compact layer. The venous plexus, shown in black, consists of spaces in the stroma of the endometrium lined by flattened (endothelial) cells. The picture suggests increased functional activity. The terminal arterioles of the radial arteries (seen with higher magnification) are more readily detected throughout the endometrium, including the compact layer, than in the section shown in the next illustration. The condition found resembles somewhat the decidua vera of early uterine pregnancy and the endometrium of early ectopic pregnancy (see Figs. 6 and 13). See also Fig. 27.

phenomenon occurs in tubal pregnancy. If the termination of the tubal pregnancy is complete (best seen after the removal of the pregnant tube), the uterus soon undergoes involution. On the other hand, if it is incomplete subinvolution takes place, the uterus remains enlarged, and the patient has attacks of uterine bleeding, often lasting several weeks (one of my cases over ten) after the beginning termination of the pregnancy. From this analogy I believe that in incomplete uterine abortion the retained products of conception still exert the influence of pregnancy as such upon the uterus and oppose the forces of involution, so that the latter process, started by the abortion, is retarded and subinvolution persists with its associated clinical phenomena.

## REPORT OF CASES

CASE 1. Age 24, clinical data incomplete. Duration of the tubal pregnancy was probably two to three months, fœtus 6 cm. long in the tube. Operation three days after the onset of symptoms, suggesting the beginning termination of the pregnancy, *i. e.*, pain, but no uterine bleeding. The pregnancy occupied the greater portion of the right tube and the fœtus, 6 cm. long, was still in the tube. The beginning termination of the pregnancy was by rupture through the upper wall of the tube, chorionic villi protruded through a small ragged opening about 5 mm. in diameter. While there was an extensive hæmorrhage into the peritoneal cavity, the fœtus was probably alive at the time of the operation.

The arteries were injected with Venetian red and the veins with ultramarine blue. The injected mass did not escape into the uterine cavity (uterine bleeding had not occurred). The uterus was enlarged to 6.5 x 5.3 cm. in the greatest transverse and anterior posterior diameters of the hardened specimen. The gross appearance of the injected uterus showed a marked dilatation of the venous plexus of the myometrium and endometrium. The

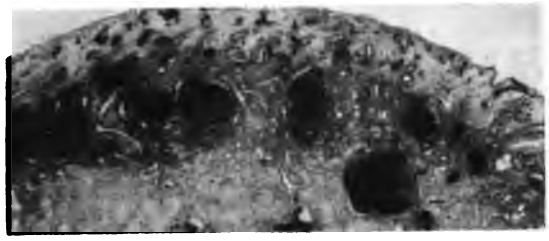


Fig. 5. Structure of the endometrium in the post-menstrual stage of the menstrual cycle. Photomicrograph (X 20) of a portion of the endometrium. Para, aged 27; uterus removed for chronic pelvic peritonitis, veins injected with bismuth. The endometrium is thin, glands small and apparently few in numbers, the deep venous spaces (black) are dilated. Arterioles are difficult to detect (seen with higher magnification). The picture suggests diminished functional activity in marked contrast to the condition shown in the preceding illustration.

latter was greatly thickened (Fig. 11).[1] Microscopically the venous plexus of the myometrium was greatly dilated, the arteries were larger than normal, and no evidence of arterial sclerosis was found.

The endometrium was greatly thickened, .7 to 1.2 cm. Small arteries were apparently more numerous and larger than in the non-pregnant condition; these were most abundant in the spongy layer. The venous spaces were dilated, especially in the middle portion. The compact layer showed true decidua with dilated venous spaces, an occasional artery, and the ducts of the glands few in numbers and compressed; the stroma of this portion was everywhere infiltrated with round cells. In the spongy layer the stroma was dense, the venous spaces dilated, and glands few in numbers and atrophied.

The enlargement of the uterus with venous and arterial hyperæmia and the presence of a true decidua were all manifestations of pregnancy. The dilated venous spaces in the decidua and atrophy of the glands in the spongy layer were manifestations of beginning involution due to regressive changes in the endometrium.

CASE 2. Age 33, para, last uterine pregnancy fourteen months before. Tubal pregnancy probably early, less than four weeks (?), symptoms began ten days after a "normal menstruation" (see also

[1] Fig. 11. (See frontispiece.) Hyperæmia of the uterus with decidua formation. Uterus of tubal pregnancy (fœtus 6 cm. long). Colored photograph (X 1) of a sagittal section of the uterus; arteries injected with Venetian red and veins with ultramarine blue. Fœtus 6 cm. long still present in the right tube (see Case 1). There was a small opening in the upper surface of the tube through which chorionic villi protruded, causing a free hæmorrhage into the peritoneal cavity. The fœtus was probably alive at the time of the operation, and the influence exerted on the uterus was that of pregnancy. Uterine bleeding had not yet begun. The entire endometrium has taken part in the formation of decidua.

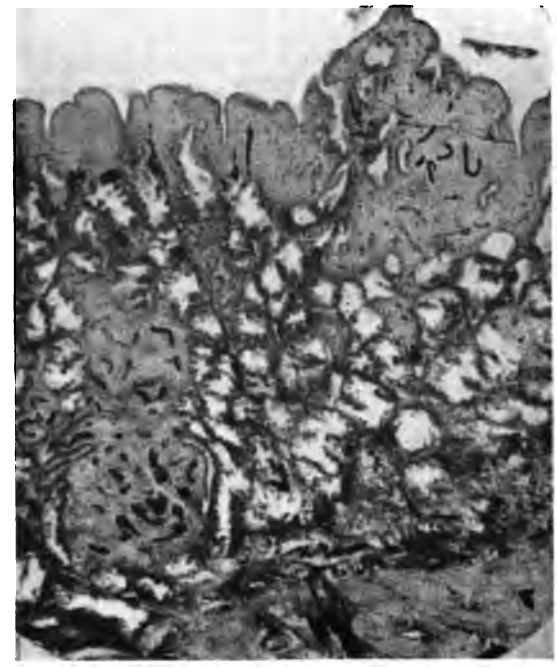


Fig. 6. The decidua vera of early uterine pregnancy. Photomicrograph (X 20) of a portion of the decidua vera. Nullipara (repeated abortions), aged 27. Uterus was removed for chronic pelvic peritonitis and an ovarian cyst. Pregnancy was an accidental finding, gestation sac, 2 cm. long, was found in the uterus, embryo not found. Arteries injected with Venetian red and veins with bismuth; both appear black in the photomicrograph.

There is a distinct compact and glandular layer. In the latter are trabeculæ (portion of one shown in the illustration) containing the terminal branches of the radial arteries. These trabeculæ convey arterial capillaries to the compact layer and unite it with the myometrium. The development of the decidua vera suggests increased functional activity, and seems to be directly dependent upon the arterial invasion of the endometrium from the terminal branches of the radial artery, which pursue a spiral course and therefore a longitudinal section of one appears as several vessels. The degree of the development of the compact layer seems to be in direct ratio with its arterial supply. Notice the rich arterial supply in the thickest portion of the compact layer.

description of the pregnant tube). Operation five days after the onset of symptoms, suggesting the beginning termination of the pregnancy, *i. e.*, pain and uterine bleeding, flowing slightly at the time of the operation. The termination of the tubal pregnancy was by rupture and incomplete, as chorionic villi were found in the tube. The ampulla of the right tube was enlarged to 2.5 cm. in its greatest diameter. An irregular opening, 1 cm. in diameter, was present in its upper surface. Neither the embryo or gestation sac were found. A small cyst was present in the opposite ovary.

The veins were injected with bismuth. A small

Fig. 7. The decidua vera of early uterine pregnancy. Photomicrograph (X 20) from the same section shown in Fig. 6, a little to one side of the latter. The same arterial trabecula is shown. A large venous space (upper left-hand portion of section) is situated at the junction of the compact and spongy layer, and smaller ones are scattered throughout the endometrium, but especially in the above situation. The extravasation of blood from these spaces into the tissues of the endometrium would tend to separate the compact from the spongy layer.

amount of the venous injection mass escaped into the uterine cavity. The uterus was slightly enlarged, to 6 x 4 cm. in the greatest transverse and anterior posterior diameters of the hardened specimen. Radiographs of cross slices of the uterus showed that the venous plexus of the uterine wall and endometrium were well injected and dilated and the latter hypertrophied (Fig. 12). There was a slight degree of sclerosis of some of the radial arteries and their branches, probably due to previous uterine pregnancies.

The endometrium was hypertrophied, 3 to 5 mm., surface irregular and covered with epithelium. The compact layer was thin and contained areas of atypical decidua formation with marked dilatation of some of the venous spaces. The spongy layer showed marked glandular hyperplasia (Fig. 13). Arterioles were more evident than in the non-pregnant uterus (Fig. 14). Uterine bleeding arose from the rupture of some of the superficial dilated venous spaces (Fig. 15). The condition found in this specimen suggests that complete involution of the endometrium would have occurred without the expulsion of a decidual cast, as the uterine bleeding

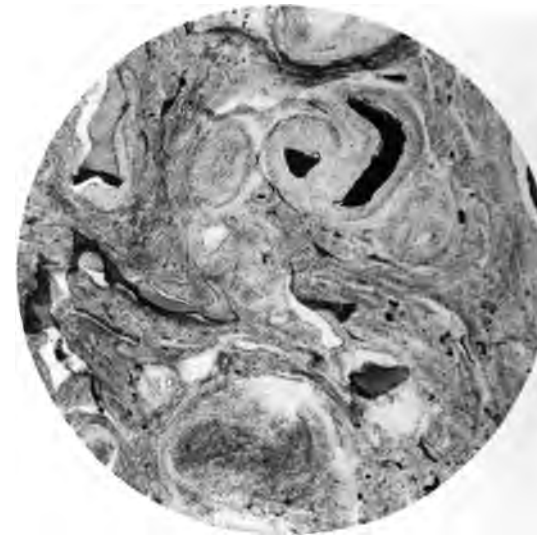


Fig. 8. Sclerotic and thrombosed branches of radial arteries following a uterine abortion. Photomicrograph (X 20) of a portion of the uterine wall. Patient aged 19; first pregnancy, abortion at the third month; hysterectomy two months later for pelvic inflammatory conditions. Arteries injected with bismuth and veins with ultramarine blue. Many of the branches of the radial arteries are sclerotic and some are thrombosed. I am unable to state the influence of the inflammatory process on the involution of the uterus. Apparently the process of involution following abortion is similar to that following full term pregnancy, differing only in degree. See next illustration.

arose from the superficial venous spaces of the compact layer, and the latter was thin.

The hyperæmia of the uterus and presence of decidua were manifestations of pregnancy. The dilated venous spaces in the decidua and escape of blood into the uterine cavity were manifestations of involution due to regressive changes in the endometrium.

CASE 3. Age 34, para, last pregnancy three years before. Tubal pregnancy probably early, missed period for nine days. See also description of the pregnant tube. Operation ten days after the onset of symptoms, suggesting the beginning termination of the tubal pregnancy, viz., pain and uterine bleeding, flowing slightly at the time of the operation. The termination of the pregnancy was by tubal abortion and incomplete. The ampulla of the right tube was enlarged to 3.5 cm. in its greatest diameter. The embryo was not found, but fragments of the gestation sac and chorionic villi were present in the tube. The opposite ovary contained a cyst 3.4 cm. in diameter.

The veins were injected with bismuth and a small amount of the venous injection mass escaped into the uterine cavity. The uterus was enlarged to 6.7 x 5.8 cm. in the greatest transverse and anterior posterior diameters of the hardened specimen. Radiographs of cross slices of the uterus showed the

Fig. 9. Sclerotic radial arteries, uterus of ectopic pregnancy, but youngest child was only twenty months old. Photomicrograph (X 20) of a portion of the uterine wall. Patient aged 34, para, youngest twenty months, ruptured tubal pregnancy; the first symptoms of termination of the tubal pregnancy occurred thirty-four days before the operation. See Case 15. Many of the radial arteries were sclerotic; it is impossible to state whether as a result of the last uterine pregnancy or recent tubal pregnancy, but probably the former.

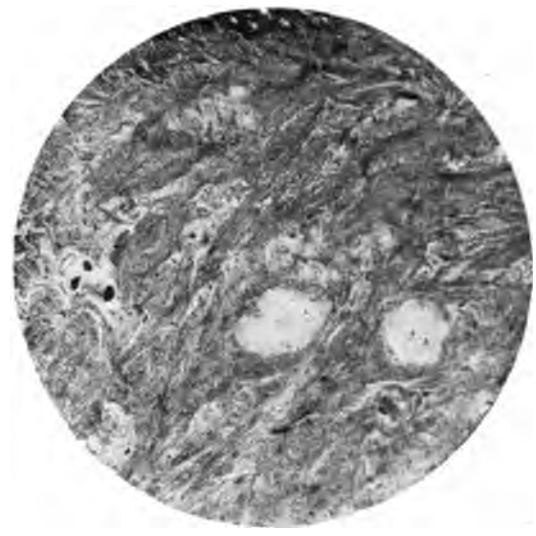


Fig. 10. Hyaline remains of sclerosed branches of the radial arteries, uterus of ectopic pregnancy, but youngest child was only eleven months old. Photomicrograph (X 20) of a portion of the uterine wall and endometrium. Patient aged 33, para, youngest eleven months old, tubal pregnancy on one side with tubal abortion and parovarian cyst with twisted pedicle on opposite. See Case 4. The hyaline areas are the probable results of the uterine pregnancy eleven months before.

venous plexus of both the myometrium and endometrium were well injected and that of the latter dilated (Fig. 16). There was a slight degree of sclerosis of some of the radial arteries. The endometrium (Fig. 17) was thickened, 3 to 4 mm., surface thrown into folds and covered with epithelium. The hypertrophy was due mainly to the dilatation of the venous spaces, especially in the distal portion (compact layer), which in places suggested atypical decidua. The glands were, for the most part, small; an occasional one showed hyperplasia. Arterioles seemed more evident than in the non-pregnant condition. The bleeding arose from the rupture of the superficial venous spaces.

The influence of pregnancy was still evident in the uterus, as shown by the thickened endometrium, decidua, and a few hyperplastic glands. The changes due to the early part of the regressive stage of involution predominated, namely, dilated venous spaces with escape of blood into the uterine cavity and atrophy of many of the glands of the spongy layer.

CASE 4. Age 28, para, last uterine pregnancy eleven months before. Tubal pregnancy probably early, missed one menstruation, onset of symptoms two weeks later. See also description of the pregnant tube. Operation twelve days after the onset of symptoms, suggesting the beginning termination of the tubal pregnancy, *i. e.*, pain and uterine bleeding, flowing at the time of the operation. The termination of the tubal pregnancy was by tubal abortion and incomplete. The left tube was distended with a blood clot (greatest diameter 4.2 cm.), in the center of which was a gestation sac 1 cm. in diameter, embryo not found. A parovarian cyst, 13 cm. in its largest diameter, was present on the opposite side; this was necrotic, due to twisting of its pedicle. It was impossible to ascertain the exact relation between the tubal abortion and twisting of the pedicle of the parovarian cyst.

The arteries were injected with bismuth and the veins with ultramarine blue. A small amount of the venous injection mass escaped into the uterine cavity. The uterus was slightly enlarged to 6 x 4 cm. in the greatest transverse and anterior posterior diameters of the hardened specimen. Radiographs of cross slices of the uterus showed that the arteries had small lumina, due to the extensive sclerosis present.

There was a marked sclerosis of many of the radial arteries and their branches, probably due to the uterine pregnancy eleven months before. The endometrium was thin, 1 to 2 mm., surface in places rough but covered with epithelium. Compact layer was absent, glands small, stroma dense, arteries small and difficult to detect, venous spaces dilated, no decidua, bleeding arose from the venous spaces. The influence of the ectopic pregnancy on the uterus had disappeared except for a retardment

Fig. 12. Venous hyperæmia of the uterus and decidua formation. Very early tubal pregnancy. Radiograph (X 1) of a cross slice, 4 mm. thick, of the uterus; veins injected with bismuth. Operation five days after the beginning termination of the pregnancy. Tubal rupture, chorionic villi in the tube (see Case 2). While involution had begun, the influence exerted on the uterus by the pregnancy still predominates (see Figs. 13 and 14).

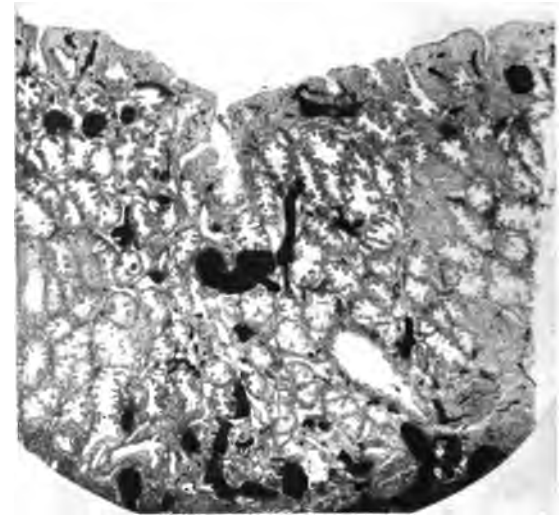


Fig. 13. Uterine decidua of early tubal pregnancy. Photomicrograph (X 20) of a portion of the endometrium from the uterus shown in Fig. 12. It resembles very closely the decidua vera of the early uterine pregnancy shown in Figs. 6 and 7. There is a distinct compact spongy layer; an arterial trabecula is present near right-hand border of the section. As in early uterine pregnancy, the development of the decidua is apparently dependent upon the arterial invasion of the endometrium from the terminal branches of the radial arteries. It differs from the decidua shown in Fig. 6 in that the arterial supply is not as well developed. The compact layer is not as thick as in the decidua shown in Fig. 11; it is a much earlier tubal pregnancy. Involution had begun, as shown by the dilatation of the venous spaces and escape of blood into the uterine cavity. (See also Fig. 15.)

of involution. The condition present was that of the regressive stage of involution.

CASE 5. Age 33, para, youngest three years, a miscarriage at the third month occurred four months before. Tubal pregnancy was probably very early, patient had not missed her menstrual period and the tube was only slightly enlarged, embryo not found. Operation twelve days after the onset of symptoms, suggesting the beginning termination of the pregnancy, *i. e.*, pain and uterine bleeding. The termination of the tubal pregnancy was by tubal abortion and apparently complete. A hematocele was found, and in removing the uterus and tube an egg-shaped clot was forced out of the tube, thus apparently completing the abortion, as chorionic villi were not found in the tube.

The arteries were injected with bismuth and the veins with ultramarine blue; a small amount of the venous injection mass escaped into the uterine cavity. The uterus was very little, if any, enlarged, 5 x 4.2 cm. in the greatest transverse and anterior posterior diameters of the hardened specimen. The gross appearance of the uterus was negative, except for a small amount of the venous injecton mass in the uterine cavity. Radiographs of cross slices of the uterus demonstrated that the lumina of the arteries were small. There was a quite marked degree of sclerosis of many of the radial arteries and their branches, probably due to recent uterine pregnancies. The endometrium was thin, 1 to 2.5 mm., surface rough, covered with epithelium. The distal portion of the stroma stained faintly as though the tissues were poorly preserved, venous plexus dilated, no evidence of decidua, glands small and appeared few in numbers. The influence of the ectopic pregnancy on the uterus had disappeared. The condition present was that of the latter part of the regressive stage of involution.

CASE 6. Age 27, first pregnancy. Age of tubal pregnancy was not determined. She thought she was three months pregnant, and had been curetted for supposed incomplete uterine abortion five days before her present operation. Operation three weeks after the onset of symptoms, suggesting the beginning termination of the pregnancy, *i. e.*, pain and uterine bleeding, flowing slightly at the time of the operation.

The termination of the tubal pregnancy was by rupture and apparently complete; the manipulation of the tube at the time of the operation may have completed the termination of the pregnancy. A hematocele was found about the right tube, which was extensively mutilated by the rupture. Chorionic villi were not found. A pyosalpinx was present on the opposite side. The arteries were injected with bismuth. The uterus was enlarged to 6 x 4.5 cm. in the greatest transverse and anterior posterior diameters of the hardened specimen. Radiographs of the cross slices of the uterus showed that the shadows cast by the radial arteries were of normal

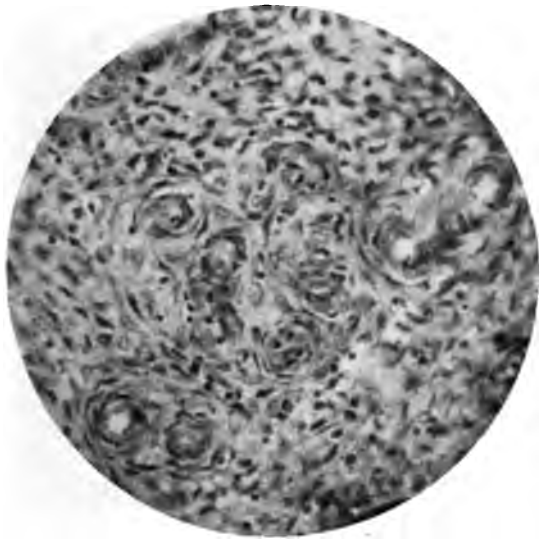


Fig. 14. Arterioles in the compact layer of the decidua of early tubal pregnancy. Photomicrograph (X 250) of a portion of the compact layer shown in Fig. 13. Tortuous arterioles with very small lumina are present in the compact layer and much more evident than in the non-pregnant condition, emphasizing that the development of the decidua and formation of compact layer are dependent upon the "arterial invasion" of the endometrium.

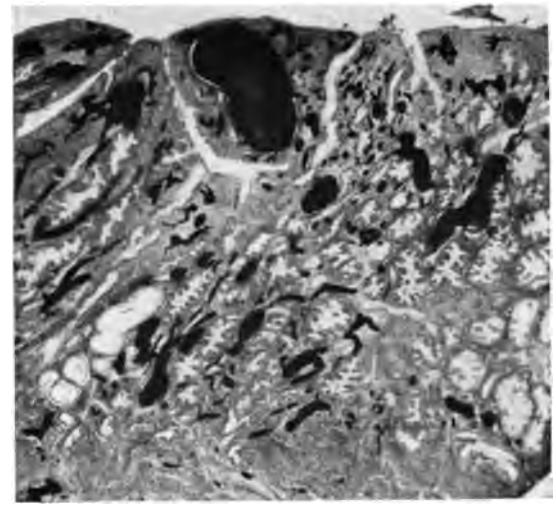


Fig. 15. Beginning involution of the uterine decidua of early tubal pregnancy. Photomicrograph (X 20) of a portion of the endometrium, Case 2, (from same uterus as Figs. 13 and 14). It shows well the dilatation of the venous spaces (black) apparently due to regressive changes in the stroma of the endometrium and possibly relaxation of the uterus. In this specimen the uterine bleeding arose from the superficial venous spaces, one shown about to rupture. Involution of the endometrium would probably occur in this case without the formation of a decidual cast, as the compact layer is thin (early pregnancy) and the rupture of the dilated superficial venous spaces would not separate the two layers.

size. There was very little, if any, evidence of sclerosis of the radial arteries, first pregnancy and only shortly after its termination. The endometrium was thin, 1 to 2 mm., rough, but for the most part covered with epithelium (curetted five days before); the glands were hypertrophied. No evidence of decidua.

It is impossible to draw any definite conclusion as to the relative influence of pregnancy and involution on account of the recent curettage.

CASE 7. Age 30, para, last pregnancy nine years before. Tubal pregnancy was very early, skipped menstrual period for five days. See description of tube. Operation twenty-five days after the onset of symptoms, suggesting the beginning termination of the tubal pregnancy, viz., pain and uterine bleeding, flowing at the time of the operation. The termination of the pregnancy was by rupture through the upper wall of the tube, incomplete. A hematocele was found about the right tube, the middle portion of which was dilated to a diameter of 2.5 cm. A small ragged opening about 3 mm. in diameter was found in the upper surface of this. A tubo-ovarian abscess was present on the opposite side. The embryo, 3 mm. in cross section, was found in a getsation sac (1 cm. in diameter) in the stained section of the tube.

The veins were injected with bismuth, and a large amount of this injection mass escaped into the uterine cavity. The uterus was enlarged to 5.7 x 5.4 cm. in the greatest transverse and anterior posterior diameters of the hardened specimen. Radiographs of cross slices of the uterus showed that the venous plexus of both the myometrium and endometrium were well injected and dilated. There was a moderate degree of sclerosis of the radial arteries.

The endometrium (Fig. 19) was thin, 1 to 2 mm., rough, but covered with epithelium, except where the injection mass had escaped. The compact layer, for the most part, was absent though persisting in places as polypoid projections. The stroma of these projections suggested atypical decidua and contained arterioles and venous spaces. The glands of the spongy layer were narrow, elongated; a few showed hyperplasia. The venous spaces were dilated. The bleeding arose from the rupture of the superficial venous spaces.

The influence of the ectopic pregnancy on the uterus was shown in the persistence of portions of the compact layer and hyperplastic glands. The regressive stage of involution presented itself in the partial destruction of the compact layer, dilated venous spaces, partial atrophy of the glands, and uterine bleeding.

CASE 8. Age 39, para, last (only pregnancy) ten years before, followed by puerperal infection.

Fig. 16. Venous hyperæmia of the uterus, especially of the plexus of the endometrium; subinvolution of early tubal pregnancy. Radiograph (X 1) of a cross slice (3 mm. thick) of the fundus of the uterus; veins injected with bismuth. Operation ten days after the beginning termination of the pregnancy. Incomplete tubal abortion, gestation sac and chorionic villi in the tube, embryo had disappeared (Case 3.) The uterus is influenced both by the forces of involution and pregnancy, and, therefore, a condition of subinvolution exists (see Fig. 17).

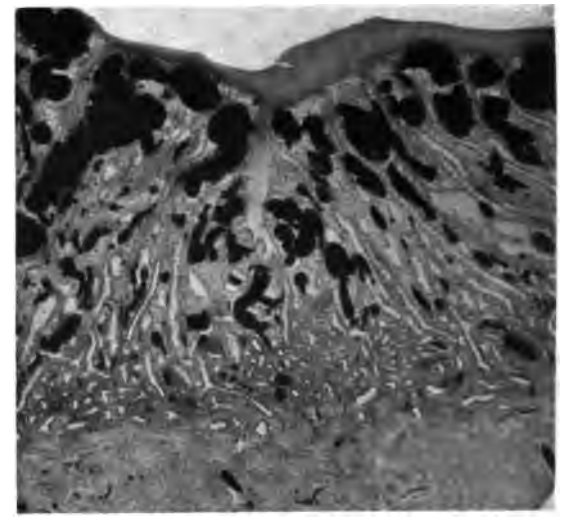


Fig. 17. Early part of regressive stage of involution of the uterus, with dilatation of the venous spaces and uterine bleeding. Photomicrograph (X 20) of a portion of the endometrium (Case 3 and Fig. 16.) The early part of the regressive stage of involution is shown by the dilatation of the venous spaces (black), especially the superficial ones and the escape of the injection mass into the uterine cavity. The majority of the glands are no longer hyperplastic. The patient has been bleeding for ten days, and involution is still in the regressive stage and is retarded by the products of conception in the tube.

Tubal pregnancy was probably very early; patient had missed her period for only two weeks. See also description of tube. Operation twenty-three days after the onset of symptoms, suggesting the beginning termination of the pregnancy, *i. e.*, pain and uterine bleeding. The termination was by tubal abortion, incomplete. The right tube was filled with a clot 3 mm. in its greatest diameter and partially protruding through the fimbriated end. A gestation sac, 1.8 cm. in diameter, without the embryo, was found in the tube.

The arteries were injected with bismuth and the veins with ultramarine blue; a small amount of the venous injection mass escaped into the uterine cavity. The uterus was slightly enlarged to 5.8 x 4.3 cm. in the greatest transverse and anterior posterior diameters of the hardened specimen. The gross appearance of the uterus was negative except for a small amount of the venous injection mass in the uterine cavity and areas in the uterine wall, which proved to be adenomyomata. Radiographs of cross slices demonstrated that the arteries contained very little of the injection mass (later shown to be due to the arterial sclerosis). There was a marked degree of sclerosis of many of the radial arteries and their branches. Many small adenomyomata were present. The endometrium was thin, 1 to 2 mm. Surface thrown into folds, covered with epithelium. Compact layer for the most part was absent, no decidua. Glands small and few in numbers, stroma dense, venous spaces dilated, only a very few arteries were seen. The effects of pregnancy had almost disappeared. The condition of the endometrium was that of the latter part of the regressive stage of involution.

CASE 9. Age 31, para, last uterine pregnancy four years before. Tubal pregnancy early, probably less than four weeks when symptoms of its termination began. See description of the pregnant tube. Operation four weeks after the onset of symptoms, suggesting the beginning termination of the pregnancy, *i. e.*, uterine bleeding, but pain had been present for only ten days; therefore probably only ten days had elapsed since the active beginning termination of the pregnancy; uterine bleeding the day of the operation.

The termination was by tubal abortion, though beginning signs of rupture were present, incomplete. A hematocele was found about the right tube which was distended (greatest diameter 3 cm.) with blood. In the center of this was the ovum, 2 cm. in its greatest diameter, and what was apparently the remains of the embryo, 3 mm. long. The arteries were injected with ultramarine blue and the veins with bismuth. The venous injection mass escaped freely into the uterine cavity. The uterus was slightly enlarged to 6 x 4 cm. in the greatest transverse and anterior posterior diameters of the hardened specimen. Radiographs of cross slices of the uterus showed that both the plexus of the myometrium and endometrium were well injected

Fig. 18. Regressive stage of involution of the endometrium with extravasation of the injection mass between the compact and spongy layers and the formation of a decidual cast. Photomicrograph (X 20) of a portion of the endometrium; veins injected with bismuth (Case 9). Operation four weeks after the first sign of uterine bleeding but only ten days after the first attack of pain. Incomplete tubal abortion, gestation sac with remnant of embryo still in the tube. Endometrium thin, glands small, extravasation of the injection mass into the tissues of the endometrium, separating the compact from the spongy layer and causing a decidual cast. A condition of subinvolution exists, still in regressive stage. The incomplete termination of the pregnancy apparently prevented the complete involution of the uterus.

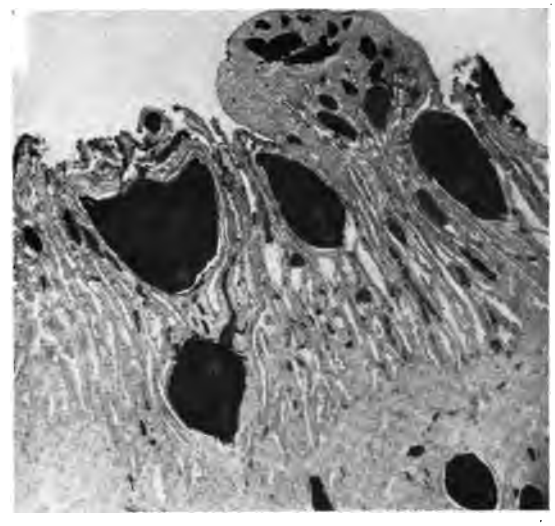


Fig. 19. Regressive stage of involution of the endometrium, dilated venous spaces and partial loss of the compact layer. Photomicrograph (X 20) of a portion of the endometrium; veins injected with bismuth (see Case 7). Operation twenty-five days after the beginning termination of the pregnancy. Termination by rupture (incomplete), gestation sac and embryo still in the tube. In places the compact layer is still present (appears as a polyp in the illustration), but for the most part it has disappeared. The venous spaces are dilated and some of the glands are still hyperplastic. The influence of pregnancy manifests itself by the persistence of areas of the compact layer and hyperplastic glands, and that of involution by the loss of the greater part of the compact layer, dilated venous spaces and atrophied glands. The influence of pregnancy has delayed the involution of the endometrium.

but not distended, probably due to the free escape of the injection mass into the uterine cavity. There was a moderate degree of sclerosis of some of the radial arteries.

The endometrium (Fig. 18) varied from 1 to 2 mm. in thickness, for the most part covered with epithelium. The compact layer resembled atypical decidua and in places was separated from the spongy layer by an extravasation of the venous injection mass, thus forming a decidual cast. The glands in the spongy layer were small and few in numbers; stroma dense. A few small arteries were seen in the base of the spongy layer.

The remains of the influence of pregnancy were still present in the compact layer of atypical decidua, which was partially separated from the spongy layer by the extravasation of the blood (injection mass). The regressive stage of involution was evident with the formation of a decidual cast, due to the above described extravasation of blood.

CASE 10. Age 37, para, youngest child fifteen years old (one miscarriage 8 years ago). Tubal pregnancy probably early when symptoms of its termination began. See description of the pregnant tube. Operation four weeks after the onset of symptoms, suggesting the beginning termination of the pregnancy, *i. e.*, attacks of pain and uterine bleeding, flowing slightly the day of the operation.

The termination was by tubal abortion, though beginning signs of rupture were present; termination incomplete. A hematocele was found about the right tube, which was distended with blood (greatest diameter 4.5 cm.). A gestation sac, 3.8 cm. in its largest diameter, was found in the tube, in which was a well-formed embryo 1.2 cm. in length. The arteries were injected with ultramarine blue and the veins with bismuth; a small amount of the venous injection mass escaped into the uterine cavity. The uterus was enlarged to 7 x 5 cm. in the greatest transverse and anterior posterior diameters of the hardened specimen. Radiographs of cross slices of the uterus showed that both the plexus of the myometrium and endometrium were well injected. There was a moderate degree of sclerosis of some of the radial arteries. The endometrium varied in thickness from 1.5 to 2.5 mm. The surface was relatively smooth, covered with epithelium. The compact layer was thin and did not resemble decidua, stroma dense, venous spaces dilated. The glands of the spongy layer were small, stroma dense. The arteries were apparently few in numbers. The dilated venous spaces, with uterine bleeding, and small glands indicated involution retarded by the pregnancy.

CASE 11. Age 34, para, last uterine pregnancy a year before. Tubal pregnancy possibly of six to eight weeks' duration before its beginning termination, as the patient had skipped two menstrual periods, but began to flow a few days after the last period was due. Operation four weeks after the

Fig. 21. Regressive stage of involution of the endometrium; extravasation of the injection mass into its tissues. Retardment of involution. Photomicrograph (X 20) of a portion of the endometrium; veins injected with bismuth (see Case 18). Operation six weeks after the beginning termination of the pregnancy. The termination was by rupture, apparently complete, but completed (last severe attack of pain two days before the operation) just before the operation. The endometrium is thin, glands atrophied, and there is no evidence of the influence of pregnancy other than the retardment of the involution. The latter is still in the regressive stage, as shown by the extravasation of the injection mass into the tissues.

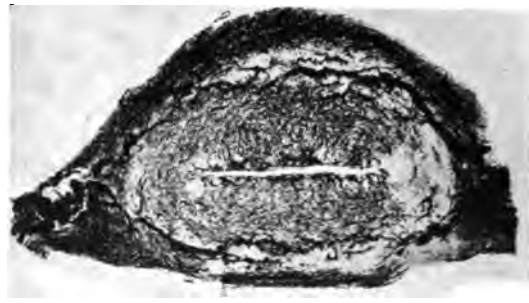


Fig. 22. Dilatation of the venous plexuses of the uterus, subinvolution of early tubal pregnancy. Radiograph (X 1) of a cross slice (4 mm. thick) of the uterus, veins injected with bismuth. Operation five weeks after the beginning termination of the pregnancy. Incomplete tubal abortion. Chorionic villi still in the tube, embryo had disappeared (Case 17). The endometrium is atrophied, but the venous spaces of both the endometrium and myometrium are dilated, suggesting a relaxation of the uterus. Involution is still in the regressive stage and its completion is apparently prevented by the influence exerted by the remains of the pregnancy in the tube (see also Fig. 23).

onset of symptoms, suggesting the beginning termination of the pregnancy, *i. e.*, pain and uterine bleeding, flowing freely the day of the operation.

The termination was by tubal abortion and incomplete. The distal portion of the left tube was distended with a pear-shaped blood clot, 7 x 4.5 cm., partially protruding through the fimbriated opening. Chorionic villi were found in this clot but not the embryo. The arteries were injected with Venetian red and the veins with ultramarine blue; there was a free escape of the venous injection mass into the uterine cavity. The uterus was slightly enlarged to 5.8 x 4.4 cm. in the greatest transverse and anterior posterior diameters of the hardened specimen. In the gross specimen the veins of the myometrium and endometrium appeared dilated, and the uterine cavity was filled with the venous injection mass, which escaped from the endometrium (Fig. 20).[1] Many of the radial arteries showed a marked sclerosis; a few arterial shadows were seen near the endometrium; last uterine pregnancy a year ago.

The endometrium varied in thickness from 1 to 2.5 mm.; its surface was covered with epithelium. A definite compact layer was lacking, no evidence of decidua. The glands were small and few in number, the stroma was dense, the venous spaces were markedly dilated, a few arteries were seen in the base of the endometrium. The dilated venous spaces, thin endometrium, absence of decidua, small glands, few arterioles, and uterine bleeding indicated the regressive stage of involution prolonged by the pregnancy.

CASE 12. Age (?), para, last uterine pregnancy three years before followed by puerperal infection; a puerperal pelvic abscess was incised and drained extraperitoneally through the groin. Tubal pregnancy was early. See description of the tube. Operation four weeks after the onset of symptoms, suggesting the beginning termination of the pregnancy, *i. e.*, pain and uterine bleeding, flowing the day of the operation. The termination of the pregnancy was by tubal abortion and incomplete. The distal portion of the right tube was distended with a blood clot, 5 x 2.8 cm., partially protruding from the fimbriated extremity. In the center of the blood clot was the gestation sac, 1.4 cm. in its longest diameter. The embryo was not found. Small bilateral ovarian cysts were present.

The arteries were injected with Venetian red and the veins with ultramarine blue; a small amount of the venous injection mass escaped into the uterine cavity. The uterus was but slightly enlarged, 5.5 x 4 cm. in the greatest transverse and anterior posterior diameters of the hardened specimen. The gross appearance of the injected uterus was negative except for a slight amount of the venous injection mass in the uterine cavity. Many of the radial arteries showed a marked degree of sclerosis (uterine pregnancy three years before). The endometrium

[1] Fig. 20. (See frontispiece.) Regressive stage of involution of the uterus and uterine bleeding. Colored photograph (X 1) of a sagittal section of the uterus, arteries injected red and veins blue (see Case 11). Operation four weeks after the beginning termination of the pregnancy; tubal abortion, chorionic villi still in the tube. The influence of pregnancy was not evident in the uterus except as involution was retarded and the regressive stage persisted with uterine bleeding.

Fig. 23. Subinvolution of the endometrium, latter part of regressive stage. Photomicrograph (X 20) of a portion of the endometrium from the specimen shown in Fig. 22. The endometrium is atrophied, glands small, venous spaces dilated and an extravasation of the injection mass has occurred into the superficial tissues of the endometrium. There is no apparent evidence of the influence of pregnancy on the uterus other than the retardment of involution.

varied in thickness, 2.5 to 3 mm.; its surface was smooth, covered with epithelium. The compact layer was œdematous, venous spaces dilated, did not resemble decidua. The glands of the spongy layer were small, stroma dense, and arterioles difficult to detect. The condition indicated the regressive stage of involution.

CASE 13. Age 37, para, last uterine pregnancy nine years before. Tubal pregnancy probably very early, skipped period fourteen days. See description of the tube. Operation four weeks after the onset of symptoms, suggesting the beginning termination of the pregnancy, *i. e.*, pain and uterine bleeding, but very little pain since the onset, suggesting that the termination was nearly completed with the first attack of pain.

The termination of the tubal pregnancy was by rupture through the upper wall of the left tube about 2.5 cm. from the fimbriated extremity. The tube was only slightly enlarged (1.8 cm. in its greatest diameter), and its lumen was filled with clotted blood. The termination of the pregnancy was not quite complete, as a few chorionic villi were found in the tube.

The arteries were injected with red lead and the veins with ultramarine blue. A small amount of the venous injection mass escaped into the uterine cavity. The uterus was enlarged 6 x 4.5 cm. in the greatest transverse and anterior posterior diameters of the hardened specimen. The gross appearance of the injected uterus was negative except for a small amount of the venous injection mass in the uterine cavity and the endometrium appeared hypertrophied. Some of the radial arteries showed a moderate degree of sclerosis. The endometrium varied from 4 to 6 mm. in diameter; the surface was smooth and covered with epithelium. The compact layer was œdematous and venous spaces dilated, and in places clotted blood in the stroma. The glands were moderately dilated, arteries in places easily detected. The thickened endometrium, with a definite compact layer, moderate glandular hyperplasia, and increased arterial supply, suggested the premenstrual stage of the endometrium, *i. e.*, a nearly complete involution of

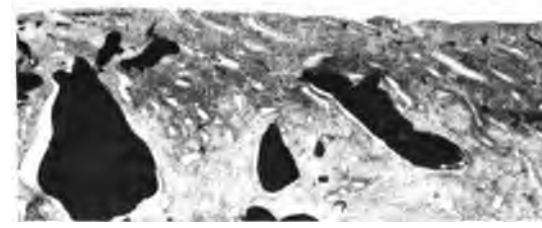


Fig. 24. Subinvolution of the endometrium, close of regressive stage or beginning reparative stage. Incomplete abortion of early tubal pregnancy. Photomicrograph (X 20) of a portion of the endometrium and myometrium; veins injected with bismuth. Operation four weeks after the beginning termination of the pregnancy. The termination was by abortion and incomplete, as gestation sac and chorionic villi were still present in the tube; the embryo had disappeared (Case 14). The endometrium is thin, surface relatively smooth, glands atrophied. Venous spaces dilated, but there was very little extravasation of the mass into the tissues of the endometrium (none in this section). Pregnancy has apparently retarded the progress of involution, and the latter is still in the regressive stage. Similar to Fig. 5 showing the postmenstrual stage.

the latter (Fig. 28).[1] Involution had been progressing for four weeks with very little interference from the remains of the tubal pregnancy, as only a few chorionic villi were present in the tube and the history suggested the nearly complete termination of the pregnancy with the first attack of pain four weeks before.

CASE 14. Age 29, para 1, and three miscarriages. Tubal pregnancy was probably early, had not missed her menstrual period. See also description of the tube. Operation four weeks after the onset of symptoms, suggesting the beginning termination of the pregnancy, viz., pain and uterine bleeding, flowing slightly the day of the operation. The termination of the pregnancy was by tubal abortion and incomplete. A hematocele was found about the left tube, which was distended to a diameter of 4 cm., a gestation sac 2 cm. in diameter was present in the tube, but the embryo was not found.

The arteries were injected with ultramarine blue and the veins with bismuth; a small amount of the venous injection mass escaped into the uterine cavity. The uterus was slightly enlarged to 5.7 x 4.5 cm. in its greatest transverse and anterior

[1] Fig. 28. (See frontispiece.) Nearly complete involution of the uterus. Colored photograph (X 1) of a sagittal section of the uterus; arteries red and veins blue. Operation four weeks after a sudden severe attack of pain and collapse, suggesting the nearly complete termination of the tubal pregnancy with the first attack of pain (see Case 13). The nearly complete involution of the uterus has taken place; and though there were still a few chorionic villi in the tube their influence had gradually subsided and recently had very little influence on involution.

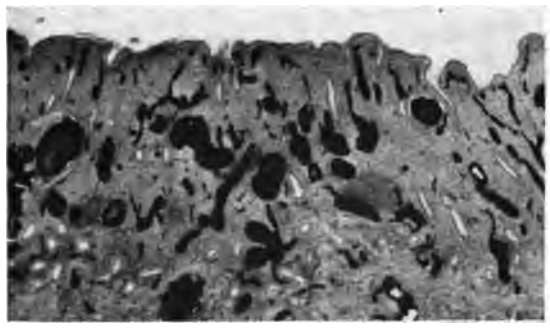


Fig. 25. Subinvolution of the endometrium, beginning reparative stage. Incomplete tubal abortion of early tubal pregnancy. Photomicrograph (X 20) of a portion of the endometrium and myometrium; veins injected with bismuth. Operation five weeks after the beginning termination of the pregnancy. A few chorionic villi were still in the tube; embryo had disappeared. (Case 16.) The endometrium is thicker than in Fig. 24, surface thrown into folds; glands still atrophied, and venous spaces dilated, but not the superficial ones. Involution has been and is still retarded by the influence of pregnancy, but the process of repair begins to manifest itself.

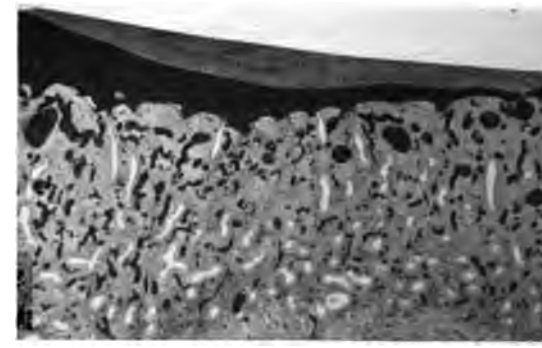


Fig. 26. Subinvolution of the endometrium, beginning reparative stage. Rupture (complete termination) of early tubal pregnancy. Photomicrograph (X 20) of a portion of the endometrium, veins injected with bismuth. Operation thirty-four days after the beginning termination of the pregnancy (Case 15). The endometrium is thicker than the one shown in Fig. 24. Surface thrown into folds. Glands larger (more active), but superficial venous spaces still dilated and the injection mass escaped into the uterine cavity. The process of repair has apparently begun, but the influence of the pregnancy, recently terminated, has retarded the involution of the uterus.

posterior diameters of the hardened specimen. Radiographs of cross slices of the uterus showed a marked dilatation of the venous plexus of the inner two-thirds of the uterine wall and the endometrium.

Some of the radial arteries showed a moderate degree of sclerosis. The endometrium varied in thickness from 1.5 to 2.5 mm., for the most part smooth and covered with epithelium. A compact layer was absent over the greater portion of the endometrium, no evidence of decidua. A few arterioles were seen, glands small, stroma dense. Venous spaces were dilated; from these the uterine bleeding arose. The thin endometrium, absence of decidua, dilated venous spaces, uterine bleeding, small glands, and poor arterial supply indicated the regressive stage of involution, apparently maintained by the remnants of the pregnancy in the tube.

CASE 15. Age 34, para, youngest child twenty months old. The age of the tubal pregnancy was not determined, but probably early. Operation thirty-four days after the onset of symptoms, suggesting the beginning termination of the pregnancy, *i. e.*, pain and uterine bleeding, flowing at the time of the operation. The termination of the pregnancy was by rupture. A hematocele was found about the left tube which had ruptured, severe pain only a few days before the operation; the embryo was not found and no chorionic villi were found in the tube.

The arteries were injected with Venetian red and the veins with bismuth; the venous injection mass escaped into the uterine cavity. The uterus was slightly enlarged, to 5.8 x 4 cm. in its greatest transverse and anterior posterior diameters of the hardened specimen. The gross appearance of the cut surfaces of the uterus was negative except for a small amount of the venous injection mass in the uterine cavity. Radiographs of cross slices of the uterus showed that the venous plexus of the myometrium was not dilated. There was a marked degree of sclerosis of many of the radial arteries, probably due to uterine pregnancy twenty months before.

The endometrium (Fig. 26) varied from 1.5 to 3 mm. in thickness, and was covered with epithelium. The compact layer was œdematous in places and the venous spaces dilated. The glands were moderately dilated, suggesting activity. The condition found suggested a beginning repair of the endometrium as in Case 13. Bleeding arose from the dilated venous spaces. The thickened endometrium with formation of compact layer, dilated glands, and increased arterial supply indicated the reparative stage of involution. The dilated venous spaces and uterine bleeding showed that the regressive stage had not ceased.

CASE 16. Age (?), para, age of children (?). Tubal pregnancy was probably early, although the tube contained a very large blood clot. Operation five weeks after the onset of symptoms, suggesting the beginning termination of the pregnancy, *i. e.*, pain and uterine bleeding, flowing slightly at the time of the operation. The termination of the pregnancy was by tubal abortion and not complete, as chorionic villi were found in the tube. A hematocele was found about the right tube, which was distended with a blood clot 7 cm. in its greatest diameter. An ovarian cyst, 5 cm. in diameter, was present on the opposite side.

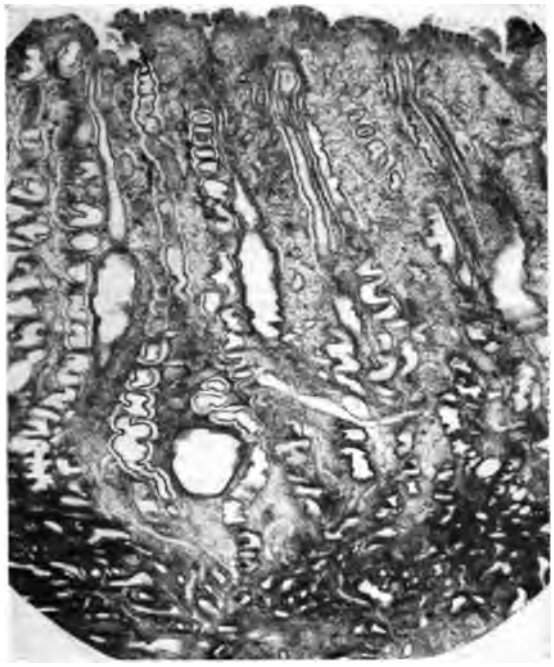


Fig. 27. Complete involution of the endometrium, end of reparative stage. Photomicrograph (X 20) of a portion of the endometrium (poorly injected). Operation forty-five days after the beginning termination of the pregnancy and two weeks after any severe pain (see Case 20). The endometrium is hypertrophied, surface rough; there is hyperplasia of the glands; the picture resembles the premenstrual stage of the non-pregnant uterus (Fig. 4).

The arteries were injected with ultramarine blue and the veins with bismuth; a small amount of the venous injection mass escaped into the uterine cavity. The uterus was only slightly enlarged, to 4.8 x 4 cm. in the greatest transverse and anterior posterior diameters of the hardened specimen. Radiographs of cross slices of the uterus showed the venous plexus of the myometrium was only fairly well injected and moderately dilated. There was a moderate degree of sclerosis of many of the radial arteries. The endometrium (Fig. 25) varied in thickness from 2 to 3 mm. Surface corrugated and covered by epithelium. Compact layer thin, no decidua, glands few in number and not hypertrophied, stroma moderately dense, arteries few in number. Venous spaces dilated. Condition suggests a beginning repair of the endometrium.

CASE 17. Age 35, first pregnancy (married ten years). The tubal pregnancy was very early, had not missed her period. (See also description of the pregnant tube.) Operation five weeks after the onset of symptoms, suggesting the beginning termination of the pregnancy, viz., pain and uterine bleeding, slight uterine bleeding at the time of the operation. The termination of the pregnancy was by tubal abortion and incomplete, as chorionic

Fig. 29. Evidence of arterial sclerosis, uterus of early tubal pregnancy (sclerosis probably due to recent uterine pregnancy). Radiograph (X 1) of a cross slice (3 mm. thick) of the uterus; arteries injected with bismuth. Operation twelve days after the beginning termination of the pregnancy; incomplete tubal abortion (see Case 4). The arteries appear to be poorly injected, due to arteriosclerosis, causing narrowing of the lumina. Compare with Fig. 1. Youngest child eleven months old, probable cause of arteriosclerosis; patient's age 28. All cases must be studied with a knowledge of the age of the patient, and if parous the date of the last pregnancy.

villi were found in the tube. A hematocele was present about the right tube, the ampulla of which was distended with a blood clot 4 cm. in its greatest diameter. Gestation sac and embryo were not found. Both tubes showed tuberculosis.

The arteries were injected with ultramarine blue and the veins with bismuth. A small amount of the venous injection mass escaped into the uterine cavity. The uterus was slightly enlarged, 5.1 x 4 cm. in the greatest transverse and anterior posterior diameters of the hardened specimen. Radiographs (Fig. 22) of cross slices of the uterus showed the venous plexus of both the myo- and endometrium were well injected and dilated. There was a moderate degree of sclerosis of many of the radial arteries.

The endometrium (Fig. 23) was in many places less than 1 mm. in thickness and covered with epithelium. A compact layer was absent, no decidua. The glands were small, few in number, stroma dense, and no evidence of tuberculosis. Arteries were not seen; some of the venous spaces were greatly dilated and subepithelial extravasations of the injection mass were present with rupture and escape of the mass into the uterine cavity. The thin endometrium, absence of decidua, small glands, poor arterial supply, dilated venous spaces, and uterine bleeding indicated the latter part of the regressive stage of involution.

CASE 18. Age 32, para, youngest twelve years old, one miscarriage two years before present operation. Tubal pregnancy probably early, had not missed the menstrual period. See also description of the tube. Operation six weeks after the onset of symptoms, suggesting the beginning

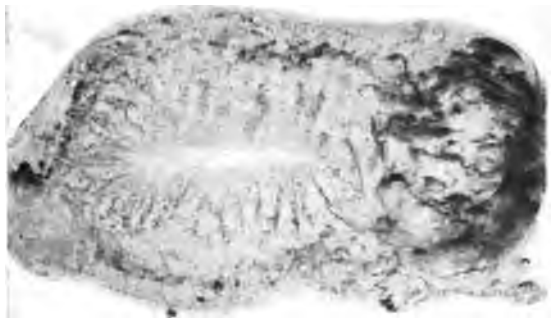


Fig. 30. Evidence of arteriosclerosis, uterus of interstitial tubal pregnancy but parous woman, youngest child nine years old. Radiograph (slightly reduced) of a cross slice (4 mm. thick) of the fundus of the uterus through the interstitial pregnancy. Arteries injected with red lead. Operation thirty-two days after the beginning termination of the pregnancy (see Case 25). The radial arteries appear to be poorly injected, due to narrowing of the lumina. There is an extravasation of the arterial injection mass between the gestation sac and surrounding uterine tissue. Patient 37 years old; last uterine pregnancy nine years ago. The degree of arteriosclerosis suggests that it may in part be due to involution of the uterus following the beginning termination of the tubal pregnancy 32 days before.

termination of the pregnancy, viz., pain and uterine bleeding, flowing freely at the time of the operation. The termination of the pregnancy was by rupture and was apparently complete, *i. e.*, chorionic villi were not found in the tube; still the manipulation of the tube at the time of the operation may have completed the termination of the pregnancy. A large hematocele was found about the right tube, the ampulla of which had ruptured.

The arteries were injected with Venetian red and the veins with bismuth. A large amount of the venous injection mass escaped into the uterine cavity. The uterus was slightly enlarged, to 5.2 x 4.1 cm. in the greatest transverse and anterior posterior diameters of the hardened specimen. Radiographs of cross slices of the uterus showed that the venous plexus of the myometrium was poorly injected and not dilated, probably due to the free escape of the mass into the uterine cavity. Microscopically many of the radial arteries and their branches showed a moderate sclerosis. The endometrium (Fig. 21) was thin, from 1 to 2 mm., rough, covered with epithelium, except where the injection mass escaped into the uterine cavity. There was no definite compact layer or decidua. The glands were small and few in number and the stroma dense. A few small arteries were seen in the stroma (11 sections examined). Only a few of the venous spaces of the endometrium were dilated. The venous injection mass had escaped into the tissues of the endometrium and from there into the uterine cavity. The thin endometrium, absence of decidua, small glands, poor arterial supply, escape of blood into the stroma of the endometrium, and uterine bleeding indicated the regressive stage of involution maintained for six weeks by the incomplete termination of the tubal pregnancy; last attack of severe pain two days before the operation.

Case 19. Age 42, married nineteen years, first pregnancy, history of a former pelvic peritonitis. Tubal pregnancy probably very early, had missed period for only a "few days." See also description of the pregnant tube. Operation six weeks after the onset of symptoms, suggesting the beginning termination of the pregnancy, *i. e.*, pain and uterine bleeding, flowing slightly the day of the operation. The termination was by tubal abortion and incomplete, as chorionic villi were found in the tube. A hematocele was found about the left tube, which was distended with a blood clot 3 cm. in its greatest diameter. A gestation sac 1.5 cm. in diameter was found in the tube; embryo not found, but shadows of villi were present. Opposite tube and ovary bound down by old adhesions.

The arteries were injected with Venetian red and the veins with ultramarine blue. A small amount of the venous injection mass escaped into the uterine cavity. The uterus was slightly enlarged, to 5.5 x 3.8 cm. in the greatest transverse and anterior posterior diameters of the hardened specimen. The gross appearance of the injected uterus was negative, except for a slight amount of the venous injection mass in the uterine cavity, which arose from the endometrium. Some of the radial arteries showed a slight degree of sclerosis.

The endometrium varied in thickness from 2 to 3 mm.; its surface was relatively smooth, covered with epithelium. The compact layer was œdematous but no decidua. The glands of the spongy layer were for the most part small, a few were dilated, and stroma dense. The venous spaces in places were dilated. A few small arteries were seen in the base of the endometrium. The condition indicated subinvolution, the latter part of the regressive stage or beginning reparative stage.

Case 20. Age 30, para, last uterine pregnancy a year before. Tubal pregnancy probably was very early. See description of the pregnant tube. Operation forty-five days after the onset of symptoms, suggesting the beginning termination of the pregnancy, *i. e.*, pain and uterine bleeding. The termination of the pregnancy was by rupture through the upper wall of the right tube about 2 cm. from the fimbriated extremity. The tube was only slightly enlarged (1.5 cm. in its greatest diameter), and its lumen was filled with clotted blood. The termination of the pregnancy was incomplete, as chorionic villi were found in the tube.

The arteries were injected with Venetian red and the veins with ultramarine blue. A slight amount of the venous injection mass escaped into the uterine cavity. The uterus was enlarged to 6 x 4.3 cm. in the greatest transverse and anterior posterior

diameters of the hardened specimen. The gross appearance of the injected uterus was negative except for a very small amount of the venous injection mass in the uterine cavity. Some of the radial arteries showed a moderate degree of sclerosis. The endometrium (Fig. 27) varies from 3 to 4 mm. in thickness; its surface was wavy and covered with epithelium, compact layer was œdematous, no decidua. The glands were hypertrophied, some of the venous spaces dilated; a few small arteries were found in the base of the endometrium. The condition resembled the premenstrual stage of the endometrium, *i. e.*, involution was complete.

CASE 21. Age 36, para, youngest sixteen years old, three years before the left tube and ovary had been removed for tubal pregnancy. Age of present tubal pregnancy probably six to eight weeks; the embryo, 4 cm. long, was found in the peritoneal cavity. Operation fifty-four days after the onset of symptoms, suggesting the beginning termination of the tubal pregnancy, *i. e.*, pain and uterine bleeding, flowing slightly at the time of the operation. Severe pain eleven days before. The termination of the tubal pregnancy was by tubal abortion and incomplete, as chorionic villi were found in the blood clot in the tube. A hematocele was found about the right tube, which was enlarged to 3.5 cm. in its greatest diameter; the fœtus, 4 cm. in length, was found in the blood clot outside the tube.

The arteries were injected with bismuth and the veins with ultramarine blue. A small amount of the venous injection mass escaped into the uterine cavity. The uterus was enlarged to 6.2 x 5.3 in the greatest transverse and anterior posterior diameters of the hardened specimen. The radial arteries showed a moderate degree of sclerosis. The endometrium varied in thickness from 2 to 3 mm., irregular in outline, covered by epithelium. Compact layer absent, no decidua. Some of the glands were hypertrophied, arteries few in numbers, venous spaces dilated. The condition present was that of subinvolution, regressive stage.

CASE 22. Age 29, para (1), ten years before. Tubal pregnancy was early, had not missed her menstrual period. See also description of tube. Operation eight weeks after the onset of symptoms, suggesting the beginning termination of the tubal pregnancy, viz., pain and uterine bleeding, slight flow at the time of the operation.

The termination of the pregnancy was by tubal abortion and incomplete. A hematocele was found about the right tube, the ampulla of which was distended by a blood clot 2 cm. in its greatest diameter. A few villi were found in the blood clot; the embryo was not found. The opposite tube was occluded.

The arteries were injected with ultramarine blue and the veins with bismuth. A small amount of the venous injection mass escaped into the uterine cavity. The uterus was slightly enlarged, to 5.3 x 4.1 cm. in the greatest transverse and anterior posterior diameters of the hardened specimen. Radiographs

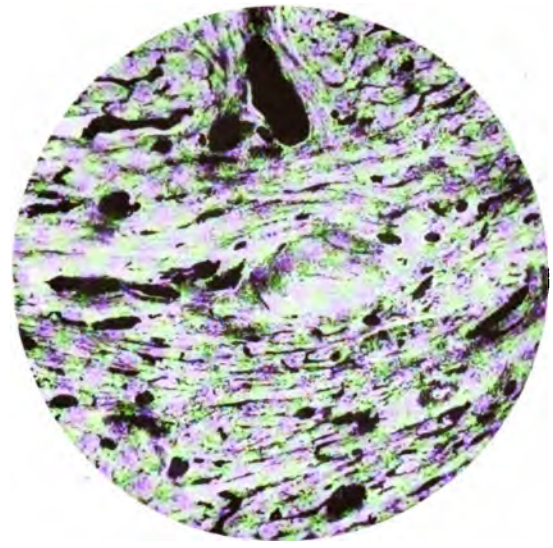


Fig. 31. Arteriosclerosis, uterus of tubal pregnancy. First pregnancy. Photomicrograph (X 20) of a portion of the uterine wall. Veins injected with bismuth. Operation seventy-two days after the beginning termination of the tubal pregnancy; incomplete tubal abortion (see Case 24). A greatly thickened artery can be seen in the center of the figure, difficult to detect from the surrounding myometrium. Venous spaces filled with the injection mass (black). Patient 36 years old; first pregnancy. Involution had been going on for seventy-two days though delayed by the incomplete termination of the pregnancy. It is possible that the involution of ectopic pregnancy is associated with arteriosclerosis of the radial arteries as is uterine pregnancy.

of cross slices of the uterus showed the venous plexus of both the myometrium and endometrium to be well injected and dilated. There was a moderate degree of thickening of some of the radial arteries. The endometrium was thickened from 2.5 to 4 mm. and covered with epithelium. The compact layer was present, dense, no decidua. The majority of the glands of the spongy layer were of small size; a few were hypertrophied. A few arteries seen at the base, venous spaces in places dilated. The condition was that of involution, reparative stage.

CASE 23. Age 36, one miscarriage four years before (induced), pelvic peritonitis three years before. Tubal pregnancy was probably very early. See also description of the tube. Operation eight weeks after the onset of symptoms, *i. e.*, pain and uterine bleeding, suggesting the termination of the pregnancy. The patient had had several hæmorrhages from the rectum, the first one five weeks before the operation, and at operation the pregnant tube was found to communicate with the sigmoid. The termination of the pregnancy was by abortion through the fimbriated extremity of the left tube into the sigmoid. The tube was filled with

a blood clot about 6 x 4.5 cm., and the opening in the wall of the sigmoid could easily admit the tip of one's little finger. Chorionic villi were found in the tube. A small cyst 4 cm. in diameter was present in the opposite ovary.

The arteries were injected with Venetian red and the veins with ultramarine blue. There was a slight escape of the venous injection mass into the uterine cavity. The uterus was only slightly enlarged, to 4 x 3 cm. in the greatest transverse and anterior posterior diameters of the hardened specimen. The gross appearance of the injected specimen was normal except for a slight amount of the venous injection mass in the uterine cavity. There was a slight sclerosis of some of the radial arteries. The endometrium was thin, from 1 to 2 mm., and covered with epithelium. A thin compact layer was present but no decidua. Many of the glands were hypertrophied and a few arteries were present. Although the endometrium was thin the presence of a compact layer, arteries, and hypertrophied glands indicated the reparative stage of involution.

CASE 24. Age 26, first pregnancy. Tubal pregnancy probably very early. See description of the pregnant tube. Operation seventy-two days after the onset of symptoms, suggesting the beginning termination of the pregnancy, *i. e.*, pain and uterine bleeding; uterine bleeding was intermittent, but present the greater part of the time from the first attack of pain. The termination of the tubal pregnancy was by tubal abortion and incomplete. A hematocele was present about the right tube, which was enlarged to 4 cm. in its greatest diameter; gestation sac, 3 cm. in diameter, with remains of embryo, 5 mm. long, still within the tube even after seventy-two days.

The veins were injected with bismuth. A small amount of the venous injection mass escaped into the uterine cavity. The uterus was enlarged to 6 x 4 cm. in the greatest transverse and anterior posterior diameters of the hardened specimen. Radiographs of cross slices of the uterus showed that the venous plexus of the uterine wall was well injected, spaces not dilated. There was an extensive thickening of the arteries of the uterine wall often difficult to distinguish from the surrounding myometrium, and this was especially true of the terminal branches of the radial arteries just beneath the endometrium. The endometrium was thin, in places devoid of epithelium, no compact layer or decidua. Glands few in number and small, stroma compact, venous spaces injected.

The regressive stage of involution was still present even after seventy-two days, apparently due to the incomplete termination of the tubal pregnancy.

CASE 25. Age 37, para, youngest nine years old. Age of ectopic pregnancy probably early (see description below), missed one menstrual period and began to flow at the time of the next regular period, when a decidual cast was passed and thought to be an early uterine abortion. Operation thirty-two days after the onset of symptoms, suggesting the beginning termination of the ectopic pregnancy, *i. e.*, uterine bleeding with very little pain, flowing at the time of the operation. The pregnancy was situated in the interstitial portion of the right tube and the cornua of the uterus was about to rupture, the gestation sac (3.5 cm. in diameter) being entirely separated from the surrounding uterine tissue by blood and the anterior wall of the uterus very thin over it. The embryo had apparently been entirely absorbed. Microscopically chorionic villi were present in the clot.

The arteries were injected with red lead and the veins with ultramarine blue. A small amount of the venous injection mass escaped into the uterine cavity. The uterus was enlarged and contained several small myomata. Many of the radial arteries showed a moderate degree of sclerosis (Fig. 30).

The endometrium was thin, 1 to 2 mm., covered with epithelium, glands were small, a few arteries in the base of the endometrium, venous spaces dilated in places, no decidua found. Subinvolution, regressive stage was still present.

## SUMMARY OF THE INFLUENCE OF ECTOPIC PREGNANCY ON THE UTERUS AND THE CAUSE OF UTERINE BLEEDING IN THESE CASES

Under the influence of early ectopic pregnancy (all my observations were confined to early ectopic pregnancy, as the largest fœtus was only 6 cm. long) the uterus becomes larger than normal. The increase in size of the uterus is due to two evident factors; *i.e.*, hyperæmia and a thickening of the endometrium. Possibly the muscle fibers are also increased in size but of this I am not certain. The changes in the endometrium are quite similar to those found in the decidua vera of early uterine pregnancy and also vary with the age of the pregnancy. In the earliest ectopic pregnancy of my series the compact layer formed only about one-fifth of the thickness of the decidua, while in the most advanced case (fœtus 6 cm. long) over one-half of the decidua consisted of the compact layer. The endometrium lining the entire cavity of the body of the uterus takes part in this change (see Fig. 11). The compact layer of the endometrium contains many arterioles (Fig. 14), about which the decidual cells first develop, and in the very early ectopic pregnancies it is difficult to distinguish this layer from the compact layer found in the premenstrual stage of the non-pregnant

uterus, just as it is difficult to distinguish the latter from the decidua vera of a very early uterine pregnancy. Spaces filled with venous blood are also found in this layer. The spongy layer is composed of hypertrophied glands as in uterine pregnancy, and in places there is very little stroma between them. Trabeculæ are also present which cross the spongy layer and unite the compact layer with the myometrium. These trabeculæ or pillars are composed of stroma and contain branches of the radial arteries and also veins, which cross the spongy layer and terminate in the compact layer. These trabeculæ are more evident than in the non-pregnant condition, though possibly not quite as evident as in uterine pregnancy. The arterioles of the endometrium are larger and appear more numerous than in the premenstrual stage of the non-pregnant uterus; they follow a spiral course, and are easily distinguished from the veins which are merely spaces in the stroma of the endometrium. There is often a decidual reaction of the stroma about the arteries in these trabeculæ. The development of the compact layer itself and also of decidual cells seems to be intimately associated with the "arterial invasion" of the endometrium which takes place through these trabeculæ. The venous spaces are found everywhere in the stroma of the endometrium, but especially in the compact layer and at its junction with the spongy layer. It is difficult to detect any change in the uterine wall other than the arterial and venous hyperæmia.

It is reasonable to believe that forcible contractions of the uterus (labor) accompany the attempts of the pregnant tube to expell its contents. The uterus develops from a fusion of the Müllerian ducts, and the clinical symptoms suggest this. These contractions by compression would lessen the arterial supply of the endometrium and otherwise damage its structure. These damages apparently cause an extravasation of blood from the venous spaces, and the ones most readily affected are those in the compact layer near the uterine cavity and at the junction of the compact and spongy layer.

Following the complete termination of the tubal pregnancy uterine involution takes place, which differs in degree from that following the termination of the uterine pregnancy. The uterus becomes smaller, due to decreased arterial and venous hyperæmia and atrophy of the endometrium. The muscle cells may also decrease in size, and I also believe that a certain amount of sclerosis of the radial arteries and their branches occurs.

We may recognize two distinct phases in the involution of the uterus following the termination of ectopic pregnancy: *first, the destructive or regressive stage;* and, *secondly, the constructive or reparative stage.*

The earliest regressive changes in the endometrium that we are able to detect are a dilatation of the venous spaces and the escape of blood into tissues of the endometrium. The dilatation of the venous spaces and escape of venous blood are most evident in the superficial portion of the compact layer and at the junction of the compact and spongy layer. The regressive changes are apparently due to (1) forcible uterine contractions injuring the structures of the endometrium; (2) interference with the arterial supply of the endometrium—the latter may be due to contraction of the radial arteries or actual sclerosis; and, finally, (3) a condition of venous congestion as shown by the dilatation of the venous spaces throughout the uterus, *i.e.*, an index of uterine relaxation. The rupture of the superficial venous spaces of the compact layer gives rise to subepithelial extravasation of blood, which soon escapes into the uterine cavity, and if this type predominates involution of the endometrium would occur without the expulsion of a decidual cast. On the other hand, the rupture of the venous spaces at the junction of the compact and spongy layer separates the two layers and may give rise to a decidual cast. In some cases the entire compact layer is destroyed in small fragments or is expelled as a cast. The glands of the spongy layer become smaller and apparently fewer in number. Although the endometrium is thinner than normal during this stage of involution, the uterus as a whole is larger, due to the venous congestion, *i.e.*, uterine relaxation. (See measurements of uteri in report of cases.) The condition present at the end of the regressive or destructive stage is an atrophied

a blood clot about 6 x 4.5 cm., and the opening in the wall of the sigmoid could easily admit the tip of one's little finger. Chorionic villi were found in the tube. A small cyst 4 cm. in diameter was present in the opposite ovary.

The arteries were injected with Venetian red and the veins with ultramarine blue. There was a slight escape of the venous injection mass into the uterine cavity. The uterus was only slightly enlarged, to 4 x 3 cm. in the greatest transverse and anterior posterior diameters of the hardened specimen. The gross appearance of the injected specimen was normal except for a slight amount of the venous injection mass in the uterine cavity. There was a slight sclerosis of some of the radial arteries. The endometrium was thin, from 1 to 2 mm., and covered with epithelium. A thin compact layer was present but no decidua. Many of the glands were hypertrophied and a few arteries were present. Although the endometrium was thin the presence of a compact layer, arteries, and hypertrophied glands indicated the reparative stage of involution.

CASE 24. Age 26, first pregnancy. Tubal pregnancy probably very early. See description of the pregnant tube. Operation seventy-two days after the onset of symptoms, suggesting the beginning termination of the pregnancy, *i. e.*, pain and uterine bleeding; uterine bleeding was intermittent, but present the greater part of the time from the first attack of pain. The termination of the tubal pregnancy was by tubal abortion and incomplete. A hematocele was present about the right tube, which was enlarged to 4 cm. in its greatest diameter; gestation sac, 3 cm. in diameter, with remains of embryo, 5 mm. long, still within the tube even after seventy-two days.

The veins were injected with bismuth. A small amount of the venous injection mass escaped into the uterine cavity. The uterus was enlarged to 6 x 4 cm. in the greatest transverse and anterior posterior diameters of the hardened specimen. Radiographs of cross slices of the uterus showed that the venous plexus of the uterine wall was well injected, spaces not dilated. There was an extensive thickening of the arteries of the uterine wall often difficult to distinguish from the surrounding myometrium, and this was especially true of the terminal branches of the radial arteries just beneath the endometrium. The endometrium was thin, in places devoid of epithelium, no compact layer or decidua. Glands few in number and small, stroma compact, venous spaces injected.

The regressive stage of involution was still present even after seventy-two days, apparently due to the incomplete termination of the tubal pregnancy.

CASE 25. Age 37, para, youngest nine years old. Age of ectopic pregnancy probably early (see description below), missed one menstrual period and began to flow at the time of the next regular period, when a decidual cast was passed and thought to be an early uterine abortion. Operation thirty-two days after the onset of symptoms, suggesting the beginning termination of the ectopic pregnancy, *i. e.*, uterine bleeding with very little pain, flowing at the time of the operation. The pregnancy was situated in the interstitial portion of the right tube and the cornua of the uterus was about to rupture, the gestation sac (3.5 cm. in diameter) being entirely separated from the surrounding uterine tissue by blood and the anterior wall of the uterus very thin over it. The embryo had apparently been entirely absorbed. Microscopically chorionic villi were present in the clot.

The arteries were injected with red lead and the veins with ultramarine blue. A small amount of the venous injection mass escaped into the uterine cavity. The uterus was enlarged and contained several small myomata. Many of the radial arteries showed a moderate degree of sclerosis (Fig. 30).

The endometrium was thin, 1 to 2 mm., covered with epithelium, glands were small, a few arteries in the base of the endometrium, venous spaces dilated in places, no decidua found. Subinvolution, regressive stage was still present.

## SUMMARY OF THE INFLUENCE OF ECTOPIC PREGNANCY ON THE UTERUS AND THE CAUSE OF UTERINE BLEEDING IN THESE CASES

Under the influence of early ectopic pregnancy (all my observations were confined to early ectopic pregnancy, as the largest fœtus was only 6 cm. long) the uterus becomes larger than normal. The increase in size of the uterus is due to two evident factors; *i.e.*, hyperæmia and a thickening of the endometrium. Possibly the muscle fibers are also increased in size but of this I am not certain. The changes in the endometrium are quite similar to those found in the decidua vera of early uterine pregnancy and also vary with the age of the pregnancy. In the earliest ectopic pregnancy of my series the compact layer formed only about one-fifth of the thickness of the decidua, while in the most advanced case (fœtus 6 cm. long) over one-half of the decidua consisted of the compact layer. The endometrium lining the entire cavity of the body of the uterus takes part in this change (see Fig. 11). The compact layer of the endometrium contains many arterioles (Fig. 14), about which the decidual cells first develop, and in the very early ectopic pregnancies it is difficult to distinguish this layer from the compact layer found in the premenstrual stage of the non-pregnant

uterus, just as it is difficult to distinguish the latter from the decidua vera of a very early uterine pregnancy. Spaces filled with venous blood are also found in this layer. The spongy layer is composed of hypertrophied glands as in uterine pregnancy, and in places there is very little stroma between them. Trabeculæ are also present which cross the spongy layer and unite the compact layer with the myometrium. These trabeculæ or pillars are composed of stroma and contain branches of the radial arteries and also veins, which cross the spongy layer and terminate in the compact layer. These trabeculæ are more evident than in the non-pregnant condition, though possibly not quite as evident as in uterine pregnancy. The arterioles of the endometrium are larger and appear more numerous than in the premenstrual stage of the non-pregnant uterus; they follow a spiral course, and are easily distinguished from the veins which are merely spaces in the stroma of the endometrium. There is often a decidual reaction of the stroma about the arteries in these trabeculæ. The development of the compact layer itself and also of decidual cells seems to be intimately associated with the "arterial invasion" of the endometrium which takes place through these trabeculæ. The venous spaces are found everywhere in the stroma of the endometrium, but especially in the compact layer and at its junction with the spongy layer. It is difficult to detect any change in the uterine wall other than the arterial and venous hyperæmia.

It is reasonable to believe that forcible contractions of the uterus (labor) accompany the attempts of the pregnant tube to expell its contents. The uterus develops from a fusion of the Müllerian ducts, and the clinical symptoms suggest this. These contractions by compression would lessen the arterial supply of the endometrium and otherwise damage its structure. These damages apparently cause an extravasation of blood from the venous spaces, and the ones most readily affected are those in the compact layer near the uterine cavity and at the junction of the compact and spongy layer.

Following the complete termination of the tubal pregnancy uterine involution takes place, which differs in degree from that following the termination of the uterine pregnancy. The uterus becomes smaller, due to decreased arterial and venous hyperæmia and atrophy of the endometrium. The muscle cells may also decrease in size, and I also believe that a certain amount of sclerosis of the radial arteries and their branches occurs.

We may recognize two distinct phases in the involution of the uterus following the termination of ectopic pregnancy: *first, the destructive or regressive stage;* and, *secondly, the constructive or reparative stage.*

The earliest regressive changes in the endometrium that we are able to detect are a dilatation of the venous spaces and the escape of blood into tissues of the endometrium. The dilatation of the venous spaces and escape of venous blood are most evident in the superficial portion of the compact layer and at the junction of the compact and spongy layer. The regressive changes are apparently due to (1) forcible uterine contractions injuring the structures of the endometrium; (2) interference with the arterial supply of the endometrium—the latter may be due to contraction of the radial arteries or actual sclerosis; and, finally, (3) a condition of venous congestion as shown by the dilatation of the venous spaces throughout the uterus, *i.e.*, an index of uterine relaxation. The rupture of the superficial venous spaces of the compact layer gives rise to subepithelial extravasation of blood, which soon escapes into the uterine cavity, and if this type predominates involution of the endometrium would occur without the expulsion of a decidual cast. On the other hand, the rupture of the venous spaces at the junction of the compact and spongy layer separates the two layers and may give rise to a decidual cast. In some cases the entire compact layer is destroyed in small fragments or is expelled as a cast. The glands of the spongy layer become smaller and apparently fewer in number. Although the endometrium is thinner than normal during this stage of involution, the uterus as a whole is larger, due to the venous congestion, *i.e.*, uterine relaxation. (See measurements of uteri in report of cases.) The condition present at the end of the regressive or destructive stage is an atrophied

opinion. But such public opinion, in order to be effective, must be intelligent and must be guided by the best scientific knowledge obtainable in order to arrive at correct conclusions and to act intelligently. Increasing knowledge of the cause of diseases, perfection of methods for their prevention, as well as the recognition of the paramount importance of regulation of social conditions for such prevention, make it necessary that there should be an educated public sentiment back of all of our efforts for disease control. The real force in this country, and the only effective force, is public opinion. Laws are the crystallization of public opinion and not one of its formative influences. When this principle is fully recognized, we will cease to advocate the adoption of mandatory laws without first creating a discriminating and intelligent public opinion on the necessity and importance of such regulation. If the education of the public is properly carried out, the number of laws required will be greatly diminished and the effectiveness of those in force will be proportionately increased.

From the standpoint of the physician, education of the public is necessary for effective work, as it is the duty of the medical profession to cure disease when it has actually occurred and to prevent disease wherever possible. As long as the causes of disease were unknown, the physician needed only the coöperation of his individual patients. To-day, my act may not harm me or my family, but may bring disease and death to my neighbor; while my neighbor's carelessness or lawlessness may be dangerous to me, no matter how law-abiding I may be. The understanding and support of an intelligent public is to-day necessary in order that the physician may effectively carry on his work and fulfill his duty to his individual patients.

Public education regarding disease and its prevention being a necessity both from the public and professional standpoint, how is this to be secured, and through what agencies is such education to be carried on? Obviously, it should be so conducted as to reach the public through the most authoritative source possible; through a medium that will be recognized as representing the entire profession, rather than any sections or portions thereof; through a single agency rather than through many, in order to avoid the confusion of the public mind which would result through a multitude of teachers. Practical conditions must also be considered. The expense and the labor required must be reduced to a minimum, and each subject must be so presented as to be intelligible to the average reader and capable of public assimilation. The many important subjects must be presented in accordance with their relative importance. The public is not in a position to distinguish between theories in the form of working hypotheses on the one hand, and demonstrated facts on the other hand; neither is it in a position to reserve judgment on a scientific question pending the production of further evidence. It is essential that only demonstrated facts which have been accepted by practically the entire medical and scientific world should be presented to the public attention. Fads, hobbies, half-baked theories, and fanciful hypotheses have no place in any scheme of public education. The recognized facts must be presented in language which is intelligible to the general public, and in a form which will be familiar. The facts must be presented in such a way as to show their practical importance rather than their abstract scientific value, and without an effort to moralize, each statement made must carry with it an implication of personal duty and responsibility on the part of the reader.

The necessity for public instruction on the prevention of disease has been recognized by practically all of our state boards of health and by many of our municipal health departments, as well as by the various federal bureaus working on public health and allied subjects. It has also been recognized by the organization of a large number of special voluntary societies, composed of those interested in some special problem and devoted to the arousing of public sentiment on this specific subject. Among such organizations may be mentioned the National Association for the Study and Prevention of Tuberculosis, The American Association for the Study

and Prevention of Infant Mortality, The American Association for the Study of the Feeble-Minded, The National Association for the Study of Epilepsy, and The American Society on Sanitary and Moral Prophylaxis. In this class belongs the new organization already referred to — The American Society for the Control of Cancer.

While the duty of the organized medical profession for the education of the public has long been recognized, and has led at different times to the appointment of special and temporary committees on various phases of the problem, it was not until three years ago that the considerations which I have discussed above led to the organization by the American Medical Association of a permanent board or council charged with the specific task of representing the medical profession of the United States before the public, with determining its relation with other public bodies, and with the education of the public on disease and its prevention.

In 1910, the American Medical Association provided for a Council on Health and Public Instruction, to be made up of five members. This Council now consists of Dr. H. B. Favill of Chicago, chairman; Dr. H. M. Bracken, secretary of the Minnesota State Board of Health; Dr. W. B. Cannon, Harvard University; Dr. W. C. Woodward, Health Officer of the District of Columbia, and Dr. W. S. Rankin, secretary of the North Carolina State Board of Health, these gentlemen representing the philanthropic, scientific, and practical public health work of the Association. Recognizing the enormous importance of this new work, the unlimited field which presented itself, and the need of laying a sound foundation for the future efforts to educate the public, the Council has, in the last three years, devoted most careful consideration to the entire problem of the education of the public in preventable diseases. While carrying on these deliberations it was necessary to inaugurate some immediate work for the establishment of better relations between the medical profession and the public.

Recognizing the importance of newspapers as public educators and as molders of public opinion, one of the first activities established by the Council was a press bureau. In July, 1910, the press bureau was established, by which a weekly bulletin was prepared and sent to five thousand newspapers. This bulletin consisted of a clipping sheet, containing short paragraphs on public health topics of current interest which were specially prepared for insertion in the public press. Letters from editors and clippings from press bulletins combine to show the growing value of this educational feature and the increasing confidence of newspaper editors in the value of this propaganda and the disinterestedness of our motives. To-day it is possible, through this medium, to place in the hands of five thousand newspaper editors material which they recognize as authoritative, representative, and animated by unselfish motives.

The necessity of a single channel of communication with the press of the country is obvious. There is to-day in the United States a constantly growing group of organizations interested in some phase of the public health problem. While the very number is uncertain, there are probably to-day nearly seventy-five such organizations. If each of these bodies attempted to maintain its own press service and to supply the newspapers of the country with material suitable for publication, not only would the expense and labor be duplicated seventy-five times, but the newspapers of the country would be bewildered and confused by the mass of material sent them; while the attempt to prepare separate bulletins on each specific subject would result in the elaboration of unimportant details and the production of an enormous amount of unnecessary material. The concentration of this material in a single bulletin, prepared specially for newspaper purposes, enables the newspaper editor to select those subjects which he regards as of importance or of special interest to his readers, and to choose a variety of topics that would not be possible if the bulletin were devoted to the discussion of a single phase of the public health question.

The most important reason, however, why such matter should be sent out by the American Medical Association is that the Association is the owner of the largest and

most complete medical printing plant in the United States, if not in the world. Owing to the development of *The Journal of the American Medical Association* and its unparalleled business management during the last fifteen years, under the editorship of Dr. George H. Simmons, the Association to-day owns a large office building, with printing plant, office equipment, and other facilities. The surplus earned by the *Journal* is distributed each year by the Board of trustees to the various boards and councils carrying on the Association work. The educational work of the Council on Health and Public Instruction is to-day made possible only by the earnings of the *Journal*, which are practically the surplus of the dues and subscriptions of physicians after the expense of the *Journal* and the Association are paid.

As the Council is the representative of the Association and the profession before the public, this bulletin is open to anybody or any organization working for the education of the public on health topics. We have the means by which the newspapers and the public can be reached. The amount of suitable material which can be so circulated is practically unlimited. Any material furnished by societies or organizations will be thoroughly welcome and effectively utilized.

The next activity undertaken by the Council was the organization of a speakers' bureau. Two hundred of the leaders of the profession in various parts of the country were asked to contribute their services to the extent of giving from six to eight addresses a year before meetings arranged by local organizations under the auspices of the speakers' bureau. One hundred and thirty-five accepted. Announcements of the bureau, giving the names of the speakers, the subjects, and conditions under which they could be secured, were sent to the secretaries of medical societies, women's clubs, universities, teachers' institutes, farmers' institutes, and other local organizations. In the case of appointments made through the bureau the speaker donates his time, the Council pays the traveling expenses of the speaker, and the local organization provides the meeting-place and advertises the meeting. In this way, by a division of expenses, the burden does not fall heavily on any one, and any city or town in which the local organization will unite for a meeting on public health can be given a speaker of high scientific ability to deliver an address on a suitable health topic.

Last year, speakers were furnished for over 350 meetings between November 1, 1912, and June 1, 1913. This year, over fifteen thousand announcements have been sent out, and the work of the speakers' bureau continues to grow in importance with each year. Here again the work of this bureau is at the service of any organization desiring to avail itself of the bureau's assistance. Speakers can be secured for addresses on infant mortality, medical school inspection, pure water, pure food or any other subject that may at the time engage the attention of the community. Additional speakers on any important subject will be welcomed. Any local organization can arrange for a public meeting and secure a speaker. The funds at the disposal of the speakers' bureau, while not unlimited, are ample to meet all demands for the present.

The next activity of the Council was the organization of a bureau of literature. Series of pamphlets on the most important subjects have been or are being prepared for distribution to those interested. Pamphlets for the protection of medical research, the conservation of vision, on general health topics, and on medico-legal and legislative questions have been prepared. Several other series are now in process of development. A single pamphlet or a series of pamphlets on cancer and its prevention can be issued by the Council without expense, provided the right kind of material can be secured.

Other plans for future development involve a lantern-slide loan bureau, a bureau of exhibits and charts, and other methods for public education.

While inaugurating these methods at once in the immediate education of the public, the most important and fundamental work of the Council at present is the investigation

of the public health situation in the United States. In addition to carrying on the activities mentioned above, the work to which the Council has decided to devote itself during the coming year is the preparation of a report on public health activities in the United States, considered under four heads, namely: Federal health activities; state health activities; municipal health activities, and private organizations. We hope to publish, by the end of the coming year, a report showing exactly what the federal government is doing for public health, and what other national governments are doing, by way of comparison; what the various state boards of health are actually doing, as shown by a personal survey by a competent authority; what is being accomplished by state boards of health, and how much it is costing; what is being accomplished by municipal departments of health, and what it is costing; what is being done by voluntary organizations, and what duplications and overlapping exist; who is paying the expenses of these organizations; what the total cost is, and what is being accomplished in proportion to the cost. Such a survey of the entire public health problem in this country has never been undertaken. When completed, it will shed light on the subject and will serve as a basis for future plans.

In addition, the Council has established a medico-legal bureau, in charge of a competent attorney, in which is being taken up the study of legislative conditions and public health legislation throughout the United States, with a view to formulating model laws on the most important subjects relating to public health, and so guiding public health legislation in the most productive channels necessary, without crowding our statute books with innumerable unenforceable laws.

Such being the general plan of the Council, the question now recurs as to the specific problem of public health education on cancer. What can the Council on Health and Public Instruction of the American Medical Association do to enlighten the public on this subject? The answer is obvious. We can place at the disposal of the American Society for the Control of Cancer and the Committee of the Clinical Congress of Surgeons of North America all of the resources of the Council on Public Health Education. Through the press bulletin, suitable material on this subject can be placed in the hands of five thousand editors without any cost to the Society or the committee. Through the speakers' bureau, addresses can be given to the public on cancer and its menace. Through the bureau of literature, local pamphlets and leaflets on this subject can be distributed. Later on, through the lantern-slide bureau and the bureau of exhibits, material on cancer and its control can be placed before the public. The agencies at work on this problem at present are the American Society for the Control of Cancer, the Committee of the Clinical Congress of Surgeons of North America, and the Council on Health and Public Instruction of the American Medical Association.

The work which needs to be done seems also to be threefold and to be peculiarly adapted to these three organizations. The first thing is to interest the public, and especially the wealthy and influential public, in the problem of the control of cancer. This is a movement for the public welfare, and there is no reason why the public should not assume part of the expense. This is the work for which the recently organized Society for the Control of Cancer is admirably adapted.

The second necessity is the careful investigation of the entire problem of cancer, its age, race, and sex incidence, its relative frequency in different occupations and locations, and all of the clinical facts connected with its appearance. There is to-day in the records of our different hospitals throughout the country an enormous mass of undigested material on this subject. This is clearly a clinical and surgical problem.

The third requirement is the distribution to the public of the results of such an investigation. This is obviously a task for the Council on Health and Public Instruction of the American Medical Association, representing as it does the organized profession of the entire country. Through its machinery, it can, without any additional expense, place

before the public any information which may be desired on this question.

The division of work which suggests itself to the careful student of the situation is this: Let the American Society for the Control of Cancer devote itself to interesting the public, especially the wealthy and influential women of our country, in the importance of the campaign against cancer and the necessity for personal support. Let the Committee of the Clinical Congress of Surgeons of North America take up the clinical side of the problem and the collection of data based on the clinical records of our hospitals. Let the Council on Health and Public Instruction of the American Medical Association, through its press bureau, its speakers' bureau, its pamphlets, and other agencies, place before the public the facts on this subject as an authoritative utterance of the organized medical profession of the United States. Such a program is concise, definite, and practical, and insures the co-operation of all forces in the field in the solution of the problem, and the control, or at least the marked reduction, of cancer in America.

---

## CONGENITAL PYLORIC STENOSIS [1]

By ROLAND HILL, M. D., C. M., Saint Louis

RECENT studies of congenital pyloric stenosis have shown it to be a disease of much importance. Until the past few years these cases were treated as cases of marasmus, and the true pathology of the condition remained an unknown factor.

The frequency of occurrence of this condition is hard to estimate, as the statistics on this point are very meagre, but observations made at the Bethesda Hospital by Dr. T. Wistar White of St. Louis, showed five cases originating in one thousand babies. This estimate of one case in every two hundred babies seems to be fairly accurate as to the frequency of the disease.

The pathology of the condition consists primarily of great enlargement and thickening of the pylorus, caused by hypertrophy of the circular muscle. This causes an obstruction of the pyloric opening that may be more or less complete. The enlargement is about the size of the last joint of the thumb, is smooth, non-adherent, and usually can be palpated through the abdomen. The stomach becomes very much enlarged, and the intestines small and shriveled.

Scudder holds that the obstruction is an anatomic one and not dependent upon physiologic causes. Its cause is unknown, but the heredity factor seems to be prominent, as two of our cases occurred in families where the condition had occurred before.

The age at onset of the symptoms of this disease is usually between the third and sixth week of life. The symptoms vary according to the degree of obstruction, and it seems certain that conditions exist varying from slight obstruction (the spasmodic type) to complete obstruction where a fine probe can hardly be pushed through the pyloric opening. Usually we have in these cases a history of a normal child until it is between three and six weeks old, when the manifestations make their appearance.

The symptoms of the disease may be considered under four heads: 1. Vomiting; 2. Constipation; 3. The gastric waves of contractions; 4. Tumor. The first symptom to attract attention is the vomiting. At first this is hardly sufficient to demand special attention, and may be temporarily improved with a change of food. Any improvement, however, will be temporary, and the vomiting soon becomes more aggravated than ever. The vomiting is distinctly projectile. The propulsive force is at times so great that a child of three months, lying on its side, has been seen to eject the contents of the stomach a distance of three feet. Occasionally the child may not vomit for several minutes after

[1] Read before the Western Surgical Association, December 20, 1913.

taking food. In the latter stages of a severe case he ejects a part or all of every feeding.

The loss of weight is very rapid. The constipation is most marked, and in severe cases may be practically absolute. Mucus alone may be found in the stools. The urine is scanty and dark in color. The appearance of the child is like that in marasmus. The face is wrinkled and the tongue and the mouth dry.

On inspection the upper part of the abdomen is found to be enlarged and the lower part narrow and empty. The outline of the stomach can frequently be seen reaching as low as the umbilicus, and on palpation gives a sense of muscular resistance greater than that of a distended colon. The muscular or gastric waves soon make their appearance. These are pathogonomic of the condition. These waves are due to peristaltic contractions of the gastric muscle. These contractions may manifest themselves in a rounded eminence rising at the left costo-chondral border where it remains a short time. Usually, however, they manifest themselves in waves passing across the epigastrium and disappearing on the right side. Sometimes three such waves are in sight at one time. They are rarely more than one inch in height. As a rule the waves occur after taking food, but may often be brought on by irritating the skin of the abdomen in the gastric region.

The enlarged pylorus may readily be palpated in the disease. It occurs as a smooth rounded mass about the size of the end of the thumb.

The diagnosis in a typical case is easily made, as the presence of tumor, the gastric waves, the malignant vomiting, so to speak, and the marked constipation, make the picture clear. The presence of enteritis and also of brain lesions in their early stages may tend to obscure the diagnosis. In the early stages the passage of a tube and recovery of retained milk is a valuable diagnostic aid.

The treatment of congenital pyloric stenosis may be considered under two heads: 1. Medical; 2. Surgical. In all our cases medical treatment had been thoroughly tried, and in several it had been persisted in so long that surgical measures offered only a long chance. Two cases coming in the past year were considered so hopeless that after being admitted to the hospital the pediatrician in charge considered it useless to seek surgical relief, and they died in a few days after admission.

The medical treatment consists in feeding by a tube. The stomach is washed out and the food inserted through the tube. Children will often retain food given in this way in the spasmodic cases where they will eject it if swallowed. In some of these cases nutrient enemeta of whey or other foods give temporary relief.

The question of when to operate in these cases is a vital one. Scudder states that an operation is indicated in all cases where a distinct tumor is palpable, and also in those cases of spasmodic variety where, under medical conditions and treatment, conditions become very grave. Lowenburg states that in determining whether or not to operate in these conditions we have three factors of importance to consider; 1. Weight; 2. Strength; 3. Character of the constipation. He gives the following rule: If a small amount of food is retained and the weight remains stationary, or there is a slight weekly gain, or if the strength does not seem to be ebbing away, and if with this we have an occasional large bowel movement, we are justified in waiting even if vomiting persists. If no food, or very little food is retained, with loss of weight and increasing constipation, patient should be operated upon before he becomes too weak.

When these cases are studied from a surgical standpoint, there are several important factors to be considered. Infants stand the shock of operations badly. They are prone to infections, and the reparative power is so slight that the wounds may simply fall apart when one would expect them to be thoroughly healed. The operations recommended in these conditions are Loret's operation or divulsion of the pylorus, gastroduodenostomy or pyloroplasty, and gastrojejunostomy. The first two of these operations have almost been discarded as being far inferior to the posterior gastro-enterostomy.

Several points regarding the preparation and operation are worthy of note. None of the very strong antiseptics have been used in our cases, simply thorough cleansing with

soap, sterile water, and alcohol. Ether is the anæsthetic of choice with babies, and a trunk of oxygen should be available. The incision is best made to the left of the median line and rather low because of the large size of the liver. The usual Mayo-Moynihahn operation is done. In the infant, however, several points are to be carefully observed. The bowel is about three-eighths of an inch in diameter and is so fragile that the least undue tension will cause the stitches to tear through like tissue paper. The finest needles and suture material are to be employed. Fine chromic catgut may be used for the inner layer of sutures, but I think fine silk, about oo in a No. 10 milliner's needle will be found the most suitable. The bowel is usually so shrunken that every care must be taken to avoid a kink. A kink caused the death of my second case.

The results obtained by treating these cases surgically were at first anything but satisfactory, but increasing experience, earlier recognition by the pediatrician, and operative intervention before the vital powers of the child too far exhausted, has led to some most brilliant results in this comparatively new field. One author reports that the statistics collected from 1898 to 1905 showed a mortality of 46.05 per cent. Haines of Cincinnati analyzed the records of 129 cases. In this series divulsion of the pylorus was done twenty-nine times with fourteen recoveries. Mortality 51.07 per cent. Gastro-enterostomy, seventy-six cases with thirty-five recoveries. Mortality 52.1 per cent. Pylorectomy in one case with a fatal result. F. S. Bunte, Cleveland, reports seven cases with four recoveries — all operations performed by anterior gastro-enterostomy. Statistics by Scudder show that he has performed fourteen of these operations with one death. Richter of Chicago reports twenty-one cases operated upon with only three deaths, while Stillman of San Francisco reports a group of ten cases operated upon with only one death.

The cases of congenital pyloric stenosis that have been referred to me for operation have all come from pediatricians of broad experience who draw their work not only from St. Louis, but from a large surrounding territory. I have operated upon ten of these cases — five have recovered and five died. This high mortality is due to two factors — faulty technique in one, perhaps two of my early cases; and almost hopeless complications in the other three. One had a meningitis develop a couple of days after operation, and two had intense jaundice at the time. The jaundice cases acted peculiarly. One lived eleven days and the other five days. Both died in the same way from the tissues simply falling apart, as nature had not made any efforts at repair.

1. Detailed histories of my cases are as follows:

CASE 1. My first case is that of H. W. P., Jr., born September 14, 1911, weight 8 pounds. The child was breast fed and seemed to get along well until fourteen days old, when he cried and vomited after each feeding. The attending physician said it was indigestion and had him taken off of breast milk and put on barley water, rice water and albumen water in succession with no result.

Child continued to vomit; his bowels had not moved except with the aid of castor oil or an enema, when the movement was black and scanty, containing a great deal of mucus. The condition gradually became more aggravated until October 19th, when a posterior gastro-enterostomy was performed. At the time of the operation the weight was 6 pounds and 13 ounces.

The child improved immediately and the second week gained a pound. At six months he weighed 13 pounds and at seven months, 13¾ pounds. At one year his weight was 20 pounds; at two years, 26 pounds. He seems to be as strong and active as any other child.

CASE 2. Virginia S., born November 26, 1911. Parents healthy. The parents have one child living, four years old. Two years ago a baby died of symptoms identical with the present case. Apparently healthy at birth. It thrived until three weeks old when vomiting began, and death occurred when six weeks old. No diagnosis was made.

Present case. The child was normal at birth. There was no more spitting up than in any ordinary baby until December 23d, when four weeks old. December 25th, parents became alarmed at severity of vomiting. As described by mother, "The vomiting was violent and often was greater in quantity than previous feeding." Baby was in poor condition; prostration, slight fever, peristalsis of stomach visible and tumor palpable.

The child was removed to the Bethesda Hospital and lavage begun. The vomiting decreased, but a large proportion of food was retained in the stomach and removed by washing. The child gradually

became worse and operation was decided upon. A posterior gastro-enterostomy was performed December 30th. At this time the weight was 6 pounds and 14 ounces.

This failed to give relief and obstruction was feared, and abdomen reopened in 36 hours. A kink was found in the jejunum owing to a misplaced stitch. The baby died January 2d.

CASE 3. C. O., born March 28, 1912. The family history is uninteresting except that this is the sixth child in the family, five of whom are living. One child died ten years ago at the age of six weeks. It was a healthy baby at birth and did well for two weeks, when it was taken with vomiting and died of inanition after four weeks' illness. This was probably a case of pyloric stenosis.

The history of the present case is that the baby, born March 28th, weighed ten pounds. She did well for three weeks, but on April 18th was taken with severe vomiting; bowels moved frequently and movements were very scant. A tumor could be palpated at pyloric region and muscular peristalsis was visible.

The child was breast fed until April 22d, when Eskay's food was tried. She retained several feedings the first day and also some the second day, April 24th. April 25th vomiting was most persistent and weakening. April 26th temperature was 99.5°. Dr. Saunders saw the case at this time and started lavage and feeding with peptonized milk. In the first twenty-four hours of this treatment, 11¼ ounces were retained, next twenty-four hours 7½ ounces were retained. After that not more than one-half ounce of each feeding retained.

Child lost very rapidly April 22d, when sick four days. Weight was 10.43; April 28th, 9.12; April 29th, 8.5, showing a loss of weight of one pound and nine ounces in thirty-six hours. The temperature was normal from April 18th, when sickness commenced, until April 26th. It then went up to 103 and continued to run 100–102 until after operation.

*Operation.* Posterior gastro-enterostomy performed April 29th, 5 P. M. The patient was treated with protoclysis and lavage. After midnight, mother's milk was given and child began to retain it. Following this there was rapid recovery. The child took the bottle in four days, vomiting gradually subsided; stools increased in amount, and the temperature became normal in five days; the decline being gradual. At the end of the first week it was found that the child had gained three ounces. During the second week she gained six ounces. From this on, recovery was very rapid. On December 11, 1913, the mother reported the child weighing 25 pounds at 20 months. Child is extremely active and enjoys splendid health.

CASE 4. Chas. G. L., male child, born May 10th, weight 8¼ pounds. The child was normal, except for a slight jaundice, until May 26th, when the characteristic signs of pyloric stenosis developed. The vomiting was projectile, constipation marked, gastric waves prominent, and a tumor palpable. The loss in weight was rapid. Jaundice was very marked. Patient referred for operation. Posterior gastro-enterostomy performed June 1, 1912. Its weight at the time was 5 pounds. Child did well for a week and then developed convulsions and died June 11, 1912.

Examination showed that the tissues had simply fallen apart both at the new opening and the abdominal wound.

CASE 5. Helen W., born June 24, 1912. The child was normal for five weeks when the characteristic symptoms of pyloric stenosis manifested themselves. Tumor palpable. Weight when admitted to the hospital, 6 pounds, 7 ounces, July 21, 1912.

Posterior gastro-enterostomy performed. Feeding in one drachm doses began six hours after operation. This amount was rapidly increased. The baby did well and was discharged cured August 10th.

CASE 6. J. E. N., born June 25, 1912, weight 8 pounds. The child was normal until July 21st, when the characteristic vomiting, gastric waves, and constipation made manifest. A tumor could not be palpated. The loss of weight was rapid. Severe jaundice existed as a complication.

Posterior gastro-enterostomy performed July 28th; weight at time, 5 pounds. The child did badly after the operation, and died August 1st. In this case the wound simply fell apart. This falling apart of the wound characterized both of the cases in which jaundice existed, as the reparative power seemed to be absolutely lacking. This was a case of the spasmodic type, as the pylorus was very little thickened and the opening was adequate.

CASE 7. Henrietta L. C. of Fort Smith, Ark., was born July 24, 1912. At birth she weighed eight pounds. Her weight increased to 11½ pounds, and child was normal until she was between four and five weeks old, when the projectile vomiting and other signs of pyloric stenosis developed. Loss of weight was gradual. She was brought to St. Louis for operation October 4, 1912. Tumor was well marked and emaciation was extreme. The child was then ten weeks old, and weighed five and three-fourth pounds.

Posterior gastro-enterostomy was performed. Anæsthetic, ether. Child fed on mother's milk. It never vomited after the operation. Gained eleven pounds in the next twelve weeks. On December 6, 1913, the father reported the child in perfect health and weighing twenty-four pounds.

CASE 8. N. B., was referred for operation, April 8, 1913, at the age of four months. The early history was not obtainable. The meager history given was that symptoms of pyloric stenosis had developed at the age of five weeks and had been persistent although a tumor was not palpable. When referred for operation, the child had a running ear and a temperature of 100. Its weight at the time was 7 pounds 15 ounces.

Posterior gastro-enterostomy was performed and the child did well for three days and then developed meningitis from which it died at the end of a week.

This case was simply one of spasm of the pylorus and a true stenosis did not exist. Examination of the cerebrospinal fluid showed that the case was simply one of meningitis from the ear infection.

CASE 9. Herbert H., born June 15, 1913; weight 9 pounds. This increased to 11½ pounds by the first of July. July 6th, commenced to have the characteristic vomiting of pyloric stenosis. This was accompanied by the other characteristic signs, including tumor. The loss of weight was rapid. From July 8th to 11th, the child lost 1½ pounds. Conditions became gradually worse until July 26th, when child weighed 5 pounds 8 ounces. Conditions were so grave that it was thought if a gastro-enterostomy were attempted the child would die on the table. In this case divulsion of the pylorus was done by means of a forcep passed through a small opening in the stomach. The pyloric muscle could be felt to give way. Four ounces of water were inserted into the bowel by means of a catheter passed through the pylorus. Conditions improved for the next few days then the child became worse and died August 3, 1913. The abdominal wound simply fell apart, and it was found that the pylorus had contracted down again.

CASE 10. Mallory P., a twin born October 11, 1913. The child was premature and at birth weighed only 4 pounds and 2 ounces. Friday, November 11th, the severe vomiting commenced, and the gastric waves became prominent. Constipation almost absolute. A tumor was palpable. Operated, November 14, 1913. Child at the time was pulseless at the wrist and had been so for more than 24 hours. Its weight was 3 pounds and 15 ounces. Its temperature was subnormal. Posterior gastro-enterostomy performed. Next day and for several days following he had several mild convulsions, would occasionally cry out with pain, but for the most part was perfectly still; eyes partly open, and unable to swallow. All food was given through a tube, beginning with a few drachms of water almost immediately after operation (within two hours). Mother's milk was given next day, at first one-half ounce every two hours, and increased to one ounce. One-half ounce of water with three per cent cane sugar was given the alternate hour. Practically all vomiting ceased, and stools became normal. It was ten days before the child could swallow, and more than a week before it could close its eyes. Gain in weight was slow, only about three ounces the first two weeks. After this the child began to improve rapidly. It gained four and one-half ounces the third week; twelve and one-half ounces the fourth week. The fifth week the gain was one pound for the week.

This is the smallest child of which I can find any record of having been successfully operated upon for this disease.

In conclusion I wish to add that all of the cases submitted to operation should be fed upon mother's milk. They should have the care of a nurse thoroughly trained in pediatrics, and a pediatrician should have charge of the feeding. These things are, I believe, absolutely necessary if the best results are to be obtained. In regard to the application of surgery to these cases, I believe I am justified in saying that the operation is justifiable if it can be shown, first, that a tumor is present; second, that the operative treatment is attended with a mortality as low or lower than the medical treatment by lavage and diet; third, if with an equal or lower mortality, it can be shown that surgery gives immediate results and saves parents the prolonged suspense of doubtful treatment that may demand operative relief in the end.

In regard to the mortality in these cases, it was high in the early series of cases in the hands of different operators. With an increased experience, however, it has come down until it is lower than medical treatment in the most skillful hands.

The second point is easily answered.

In the doubtful cases treated by lavage, the outcome is in doubt for several weeks at least; the treatment is nerve-wrecking and the outcome uncertain.

Surgery, on the other hand, yields results almost instantaneous, and a child that to-day is crying, vomiting all nourishment and the picture of marasmus, may in a week's time present a condition of rapid convalescence and contentment.

## REFERENCES

1. SCUDDER. Surg., Gynec. & Obstet., April, 1912, xiv, 373
2. H. LOWENBURG. N. Y. M. J., 1912, January.
3. HAINES. Pediatrics, 1910.
4. BUNTE. Am. J. M. Sc., 1912, January.

# OPERATIVE TREATMENT FOR MALFORMATIONS OF UTERUS AND VAGINA [1]

By J. M. MUNRO KERR, M. D., Glasgow, Scotland
Muirhead Professor of Obstetrics and Gynecology, Glasgow University; Gynecological Surgeon, Royal Infirmary; Hon. Fellow, American Gynecological Society

ALTHOUGH gynecological surgeons frequently encounter malformation of the reproductive organs, for they are much more frequent than the general medical public suspect, there are singularly few contributions to the surgery of such malformations. There are, of course, many contributions relative to individual varieties, but with the exception of Goullcound's thesis, "Du Traitement des malformations utérines justiciables de la laparotomie," [2] I can find few contributions which deal with the subject in general.

The time, therefore, has come when we should consider a little more than we have done in the past how these malformations may be remedied or improved.

I propose to consider malformation under the following heads:

A. Where fusion of the Müllerian ducts has occurred, but development of the uterus has been arrested.

B. Where the Müllerian ducts are fused, but the two halves of the uterus are divided by a more or less complete septum.

C. Where the two Müllerian ducts are more or less imperfectly fused.

D. Where the deformity affects the vagina more especially.

## A. WHERE FUSION OF THE MÜLLERIAN DUCTS HAS OCCURRED BUT DEVELOPMENT OF THE UTERUS HAS BEEN ARRESTED.

*Infantile uterus.* In the simplest of all malformations, the infantile uterus, I have never been able to secure a satisfactory menstruation nor have I ever seen a pregnancy occur. I have sometimes seen a small uterus respond to such local treatment as dilatation, electricity, repeated curettage, etc., and a more satisfactory menstruation and even a pregnancy occur, but the true infantile uterus is, in my experience, a hopeless organ to remedy. In many cases it is even worse than that, for it is frequently the cause of great discomfort to the possessor. We are familiar with the extreme dysmenorrhœa frequently associated with the condition and which in former years led surgeons to remove the ovaries, but which is now rightly dealt with by hysterectomy.

*Uterus fœtalis.* In the more extreme varieties, such as the uterus fœtalis, menstruation is generally absent. If present it is late in making its appearance, only occasionally occurs, and is very scanty. It is often associated with dysmenorrhœa, but in several cases which I have had under my care there was no dysmenorrhœa or menstrual discharge. I have seen the condition in women of specially good physique as well as in women delicate, small, and ill-developed. The external genitalia and the ovaries are generally poorly developed. Nothing can be done for such cases, but operative interference is only indicated when extreme dysmenorrhœa is affecting the general comfort and health of the individual, and here again total hysterectomy is preferable to oöphorectomy.

*Uterus rudimentarius.* A more pronounced degree of malformation in which the uterus is rudimentary — uterus rudimentarius (encavatus or solidus) — is an error of development of a much earlier date. In this variety the uterus is small, generally with a single small cervix and two elongated tubular bodies; in extreme cases there may be no cervix. In this variety of malformation the more rudimentary the uterus the less likely is there to be any pain and discomfort of a periodic nature, but in some cases, both where the tubular bodies are solid and where they are canalized, severe periodic pain has necessitated complete removal. In two cases recently examined the women were well de-

[2] Ann. de Gynéc., 1912, Oct., Nov., Dec.

[1] Read before the Obstetrical and Gynecological Section of the International Congress, London, August 1913.

veloped and with good-sized breasts. The vagina is often absent or if present is small. In one or two cases the glands have been well-developed testicles and not ovaries. A case recently operated upon by Russell Andrews was of this nature, and yet the individual appeared to be a well-developed woman. This fact is peculiarly interesting in connection with the internal secretions and the influence these have upon the growth and development of the individual.

Here again nothing can be done for the condition in the way of making a healthy functionating organ, but when the vagina is absent a canal may be artificially made. We shall refer to this later when speaking of malformation of the vagina.

*Atresia cervicalis.* From the infantile uterus with its subdivisions we naturally pass to the cases in which the cervical canal is obliterated in its whole extent or at the site of the internal or external os.

Patients with these conditions may suffer no discomfort if there is no menstrual accumulation (hæmatometra) or if there is no periodic uterine contractions, but they will suffer pain if a menstrual discharge gets pent up with the formation of a hæmatometra or if there is active uterine contraction of a periodic character.

In dealing with such cases surgically it is obvious that little benefit will be secured by establishing a cervical canal if there is no evidence of periodic pain or uterine hæmorrhage, for the women are hopelessly sterile. But, on the other hand, if there is evidence of an accumulation of blood in the uterus some plastic operation on the cervix may result in the relief of the periodic pain by allowing a free escape of menstrual blood. In a few cases pregnancy even may occur. Naturally, the best results will be secured in those cases where the atresia is located to the internal or external os. In the cases where plastic operations are impossible hysterectomy offers the only cure.

*Atresia of internal os.* We are all familiar with stenosis of the internal os — with those cases in which the sound passes readily through the cervix until it reaches the internal os, and where, with little force, we manage to get it pushed through and kept patent by repeated dilatation or a stem pessary. Personally, I have not encountered a case where there was absolute obstruction limited to the internal os, and so I think it must be very rare indeed.

In dealing with cases of genuine atresia of internal os, different methods may be employed. A common practice was to force a passage with sound or metrotome and keep it patent by means of a stem pessary. But surely with our present surgical knowledge such a method is crude.

A very ingenious suggestion is the one made and actually employed by Goullcound and termed by him "trachelostomie." It is performed as follows: The abdomen having been opened and the bladder pushed down, the uterus is split up the middle line. The obstructing tissue at the os internum is then excised, the uterine and cervical edges of mucous membrane are stitched, and a stem placed in the cervix. Finally, the two edges of the uterine wound are stitched together. The illustration explains the manner in which the operation is performed.

Goullcound mentions a case reported by Engstrom[1] where the latter opened the uterus and established a canal, dilated it and pushed down a piece of gauze through it into the vagina. One tube distended with tea colored fluid was removed.

Personally, I think where there is any thickness of tissue it would be better to push the bladder well off the cervix and excise, by transverse incisions, the obstructing ring of tissue. Finally, an end-to-end anastomosis of cervix to body should be made much in the same manner as that suggested by Mayo[2] for dealing with myomata of the cervix.

One thing, however, is of prime importance and that is to open the abdomen in the first instance in all the more complicated cases of atresia of vagina or cervix. In reading over the literature of the subject one is struck by the frequent disasters which have followed dissections and tappings from the vagina. Most recent papers, as, for example, those of

[1] Zentralbl. f. Gynäk., 1899, p. 923.

[2] Surg., Gynec. & Obst., Feb., 1911, p. 100; Ann. de Gyn., Nov. 1912, p. 700.

Veit[1], Lichtenstein[2], Goullcound, support this procedure.

*Atresia of external os.* We are all familiar with this condition in obstetrical practice, and have dealt with it by making a crucial incision when the cervix was obliterated and the presenting head stretched the cervical canal. Some of us have seen the uterine contractions overcome the obstruction and carry away part of the thinned-out portio vaginalis. In gynecological practice, however, it is not common to encounter it and very difficult to distinguish it from a cervix completely obliterated. When the condition is suspected and a hæmatometra exists a trochar and cannula may be employed with great care and the portio punctured at its apex. If the accumulation of blood is readily reached one will conclude that only the region of the internal os is obliterated, but if the hæmatometra cannot be tapped, or only tapped with great difficulty, one concludes that the whole canal of the cervix is atresic. Where an atresia exists only in the neighborhood of the external os and a good-sized trochar has been inserted, the operator should cut a circular wedge from the lowermost portion of the cervix and unite the mucous membrane of the canal with the mucous membrane of the vaginal surface of the portio.

*Atresia of the whole cervical canal.* In this condition our difficulties in establishing a satisfactory canal are much greater. This is especially the case in this variety because the upper part of the vagina is often atresic. The older methods were to attempt to establish a communication by knife, trochar, and cannula from below. This, as I have said before, is crude, and as the recorded cases show is attended with great danger to the patient.

A somewhat safer proceeding was that adopted by Ludvig[3] in a case of hæmatometra with a non-canalized cervix. He opened the abdomen and found no distention of the tubes, only some free blood in the pouch of Douglas. He then opened the uterus and pushed a trochar and cannula through from the uterus into the vagina. In criticizing the proceeding Wertheim mentioned a case where he had established a fistulous opening between the lower part of the body and the vagina by suturing the uterine body to vagina (ventrofixation). A somewhat similar proceeding was adopted by Halban[4] who fixed the fundus to the vagina.

It is not surprising that operators in recent years should have been abandoning such crude methods, and should have been attempting to establish a permanently patent canal by removing the intervening tissue and resecting and uniting the two ends by means of sutures. As we shall see when atresia of the vagina is under consideration, this method of dealing with gynatresia is not difficult when the atresia is confined to the lower third of the vagina or where the obstruction involves only a small portion of the cervix and vault of the vagina. But if there is a considerable portion of tissue intervening involving cervix and upper third of vagina it is extremely difficult to establish an end-to-end anastomosis and a satisfactory utero-vaginal canal. This was well seen in the case recorded by Cohn[5]. Cohn failed to establish this union of the two ends and was finally compelled to perform hysterectomy. Without doubt the ideal procedure is to open the abdomen, examine the adnexa, and separate off the bladder until the vaginal rudiment is reached. This is infinitely safer and more surgical than dissecting one's way up from below without knowing what is the condition of the adnexa.

### B. WHERE THERE IS FUSION OF THE TWO HALVES OF THE UTERUS, BUT A MORE OR LESS COMPLETE SEPTUM DIVIDES THEM.

1. *Septum complete.* (Uterus septus or uterus bilocularis.) In this variety of malformation there appears to be little disturbance of general health or menstruation unless there is atresia of one cervix. Hæmatometra in this variety is very rare. Parturition too is frequently easy, although by no means always so.

[1] Prakt. Ergeb. der Geburtsh. u. Gynäk., 1909.
[2] Zentralbl f. Gynäk., 1912, p. 225.
[3] Zentralbl. f. Gynäk., 1900, p. 653.
[4] Ztschr. Geb. u. Gynäk., 1903, xlix, 17.
[5] Zentralbl. f. Gynäk. 1908, p. 1593.

A very striking example of dystocia caused by this malformation is the one recently described by Bethin[1] where cæsarean section was necessary. The author in his paper is more concerned in discussing the advantages of cervical cæsarean section than in considering the most suitable operation for this particular malformation. We are inclined to think from the description of the case and the illustrations which accompany his most interesting paper that the operator might have employed a median longitudinal incision, and removed the whole septum after extracting the child.

The most natural course to pursue in cases of this nature which call for operative interference during pregnancy and parturition is obviously removal of the septum after splitting open the uterus. From recorded cases we are quite convinced this might generally be done without much difficulty.

As regards the non-gravid uterus matters are quite different. We believe that in these cases the septum can best be reached and removed in the following manner: Open the abdomen and examine the uterus and adnexa. Then make a transverse incision across the uterus at the lowermost part of the body. Just divide the uterus to about the extent of two-thirds, turn back the two halves of the uterus, and by that means one can readily reach the septum of body and cervix and remove it with scissors. Pack some ribbon gauze into uterine body and push down the end through cervix. Then suture divided uterus with catgut. Such an operation could be performed either per abdominem or per vaginam. Personally, I think the abdominal route is always the best, and especially in dealing with malformations.

Some critics may contend that this variety of malformation so rarely disturbs menstruation or parturition that it is unnecessary to deal with it. I admit that there are many cases where women with uterus bilocularis have had repeated normal parturitions, but if you search carefully the literature you will find a considerable number of cases of abortion, premature labor, placenta prævia, dystocia, post-partum hæmorrhage. I consider, therefore, that it is always desirable to remove the septum in a uterus bilocularis. Strassmann[2] gives an interesting account of two cases, in one of which the removal of the septum was attended by most gratifying results.

As regards those extremely rare cases in which one half is the seat of a hæmatometra, I can conceive of no better procedure than the one I have suggested; viz., approaching the septum by a transverse incision just above the isthmus. It would be extremely difficult to excise a hæmatometra of this eariety, but fortunately all that is necessary in this complication of uterus bilocularis is to remove the septum. This being removed there can be no further accumulation of blood in the atresic half, and pregnancy and parturition should not be unduly disturbed.

I feel confident, then, that this variety of malformation will ultimately be satisfactorily dealt with in some such manner as has been indicated.

*Partial septum.* (Uterus subseptus.) In cases of this variety, where the septum is limited to the fundus, parturition may be disturbed, but menstruation and general health are not affected unless there is some other complication. In such cases the child may be born without much difficulty, but oblique presentation of the child and retention of placenta are not infrequent. Such complications I have seen upon three or four occasions, and all writers refer to the frequency of these occurrences.

Judging by the recorded cases and those which I have seen, I am not convinced that operative interference is necessary in this variety of malformation. But it would be a very simple matter to remove the septum in the manner already recommended for uterus bilocularis.

A more radical proceeding would be to resect the uterus as Strassmann has recommended.

Where the septum is limited to the lower part of the *uterus subseptus cervicalis* miscarriages seem to be unusually frequent and

[1] Monatschr. f. Geburtsh. u. Gynäk. 1912, xxxv, 162.

[2] Berl. klin. Wchnschr., September 9, 1912.

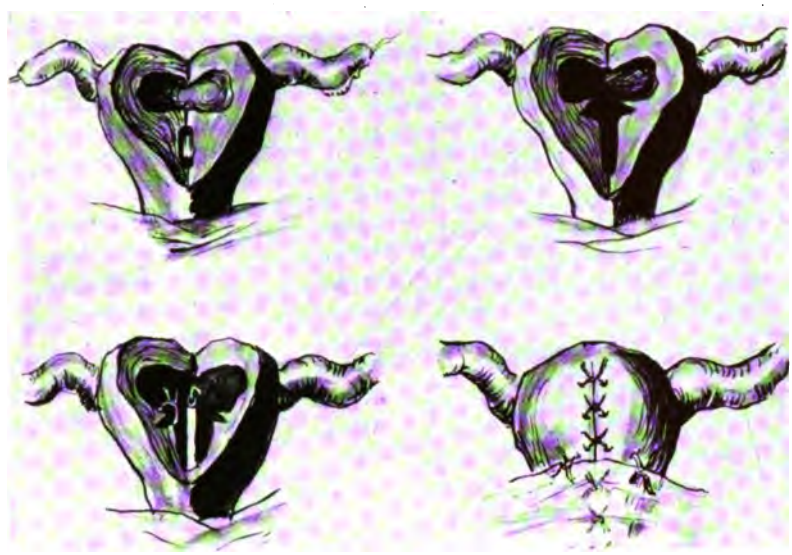


Fig. 1

dystocia naturally may be extreme. There are a considerable number of cases recorded where the delivery has had to be terminated by version, craniotomy, or cæsarean section. The diagnosis is not difficult. In the non-gravid, by passing a sound through each cervical canal one can tell the extent of the septum. Neither should it be difficult in the parturient, for if the cervical septum is divided and the cervix is dilated one will be able to tell by anæsthetizing the patient and passing one's hand into the vagina and the fingers into the uterus whether or not there is any septum in the body. In the pregnant, however, it will generally be necessary to wait until labor occurs.

The treatment of the condition is simply to excise the septum. In the non-gravid this might be done from the vagina. The bladder could be pushed off the cervix and the uterus divided as in vaginal cæsarean section. The septum could then be readily excised, the uterus plugged with gauze, and the uterine wound sutured.

If the condition has to be dealt with during labor it is unnecessary to divide the cervix, for the septum can be divided by scissors under the protection of one or more fingers passed through the dilated cervix.

### C. WHEN THE TWO MÜLLERIAN DUCTS ARE MORE OR LESS IMPERFECTLY FUSED

*Uterus cordiformis—uterus arcuatus.* This is the simplest variety of this group of malformations. The depression at the fundus varies, and not infrequently there is a septum more or less marked. Where the depression is very slight and the septum well marked, the malformation really assumes the form of the uterus subseptus, while at the other extreme where the depression is deep and the two bodies markedly separated it passes into the uterus bicornis unicollis, the next variety to be considered. Now, it is important to appreciate this, for the surgical treatment differs, if surgical interference is necessary, according as the uterus cordiformis assumes the former or the latter type. This will be best appreciated by considering the surgical treatment which has recently been proposed and carried out by Strassmann.

Strassmann's first contribution to the subject appeared in 1907[1] and his latest communication, as far as I know, appeared last year.[2] The operation recommended by Strassmann consists in suturing the two halves together after cutting a wedge out of the two

[1] Zentralbl. f. Gynäk. 1907, p. 1322.

[2] Berl. klin. Wchnschr. 1912, September. 9, 1750.

halves. It is best understood by the accompanying illustration.

In his last communication Strassmann was able to record two spontaneous births at full time. The result was most satisfactory, for the woman prior to the operation had had eight miscarriages. In the paper he mentions cases operated upon by Puppel and Truzzi.

Personally, I have seen a considerable number of cases of uterus cordiformis and uterus bicornis unicollis, and in looking back on them I believe some might have been satisfactorily dealt with in the manner described by Strassmann. I feel also quite certain of this, however, that the more nearly the uterus cordiformis approaches the uterus bicornis unicollis the more difficult will re-

Fig. 2

section be. In the last case of bicornic unicollis operated upon and which I shall describe when considering that variety of malformation, it would have been futile to attempt Strassmann's operation. But I believe when the uterine bodies are incompletely divided and when there is a wide entrance so to speak into each cornu, an operation such as Strassmann has described might be carried out with great benefit to certain patients.

Further, I would say this in regard to Strassmann's operation, that I am entirely opposed to the vaginal route. I feel certain it is infinitely safer to deal with these cases through an abdominal incision as Puppel and Truzzi did.

From what I have said it is obvious that resection of the uterus can only be performed in the simpler forms of double uterus so that critics might say: Is it really necessary or of much advantage to resect a uterus in such cases?

Personally, I do not agree with such critics; if one consults the literature on the subject one finds that abortions, premature births, malpositions of child, post-partum hæmorrhage, retention of placenta in one horn, and sepsis are by no means infrequent. Having had no experience of the operation, I cannot write with any authority, but I think that resection might be employed with advantage in carefully chosen cases.

*Uterus bicornis unicollis.* This is one of the commonest of the marked deformities which we encounter, and many cases have

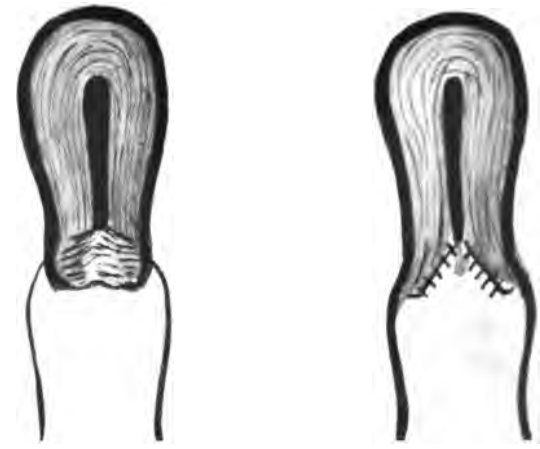


Fig. 3

been recorded, particularly the variety in which one cornu is rudimentary. We are at present considering, however, the variety in which both horns are symmetrical. I have seen several cases of this variety and have twice opened the abdomen and accurately observed the malformed uterus *in situ*. The first case was not of special interest; it was a case of double salpingo-oöphoritis. The tubes and ovaries presented the ordinary appearances of this condition, so they were removed and the uterus left. The patient made an excellent recovery and was much relieved of her discomforts.

But the second case was of particular interest, and was operated upon by me in a private nursing home about eighteen months

ago. The result which followed the hemihysterectomy I performed has been so successful that I make no apology for describing the case in some detail.

The case was that of a young lady aged twenty who was brought to me by her mother on account of extreme dysmenorrhœa. She was a healthy, well-developed woman, bright and intelligent. Her menstruation was occasionally slightly late, but of about the normal character as regards duration and quantity of discharge. Her mother informed me that she had been in the hands of another gynecologist for a number of years and that he had dilated the cervix and removed one ovary which was slightly enlarged. She also told me that at the operation he had discovered a double uterus and that he now proposed that the other ovary should be removed, as the dysmenorrhœa was as bad as ever. I informed the patient and her mother that I could offer no

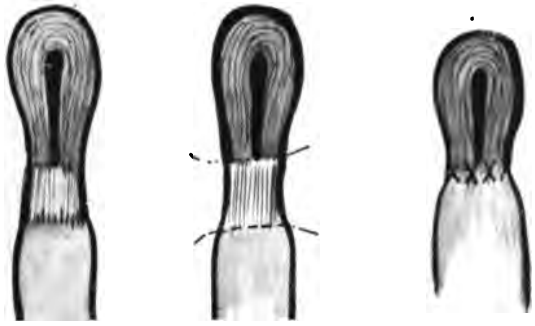


Fig. 4

opinion until I had examined the patient under an anæsthetic. This I did and found a symmetrical uterus bicornis unicollis. I could get the sound into the right half readily but not into the left half. Asked for my opinion as regards treatment, I informed them that I was absolutely opposed to removing the other right ovary. I also informed them that I was inclined to think that the dysmenorrhœa might be relieved by removing one uterine horn, for although the pain was not limited to one side, I thought in all probability the two cornu were contracting irregularly and certainly the canal of the left half was narrower than the right. I proposed, therefore, a hemihysterectomy. A few days later I performed that operation and the result has been beyond my expectations, for she has now no pain at her menstrual periods, which are absolutely regular and normal. I see no reason why she should not marry and have children. She has a normal-sized uterus unicornis and a healthy right ovary and tube.

I feel certain this procedure is well worth considering in cases of this nature, for dysmenorrhœa is very frequent with uterus bicornis unicollis. Certainly one should try this course prior to performing hysterectomy when radical treatment is necessary. Oöphorectomy, of course, is a most undesirable proceeding.

The extreme dystocia which may occasionally occur is exemplified in Galabin's[1] case, in which cæsarean section was necessary because the child developed partly in one half and partly in the other.

*Rudimentary horn.* The variety of double uterus in which one horn is rudimentary is a condition so well known that it is unnecessary for me to take up time with its consideration. We are all familiar with this condition, as-

Fig. 5

sociated sometimes with hæmatometra and at other times with pregnancy. For both these complications it is frequently necessary to operate, because the former is often associated with a considerable amount of pain and the latter generally terminates in ruptures. By all of us it is now admitted that the ideal procedure is to remove the rudimentary horn and leave the normal horn behind, and so satisfactory has been this procedure that on several occasions pregnancy has occurred and continued on to term. The removal of the rudimentary horn in the two cases which have been under my care was singularly easy, and the stump was readily covered with peritoneum. Occasionally, however, the operator has found that the gravid horn has burrowed down towards the pelvis. In these

[1] Tr. Obst. Soc., Lond., xxxvii.

latter cases there may be a considerable difficulty in removing the horn. Indeed, the difficulty may be so great that the operator is compelled to remove the whole uterus, as for example in the case recorded by Wilson.[1]

*Uterus didelphys.* In this variety of malformation the general health, menstruation, and parturition are rarely disturbed if each half is well developed and there is no obstruction of either vaginal canal. Such cases, therefore, rarely call for surgical interference. I have seen in connection with my private and hospital practice several cases of this nature. In the two cases in non-pregnant women the condition was discovered at the time of examination, and the discomforts complained of could in no wise be attributed to the malformation. In the four cases seen in parturient women the vaginal septum had twice to be divided. A summary of these cases will be found in *Operative Midwifery.*[2]

Such complications as backward displacement or hæmatometra of one uterine half, atresia of one cervix, fibromyoma, and even carcinoma of one or both halves, have been recorded, and may arise as complication, and disturb the general health, menstruation, and parturition, but they are of extreme rarity. It stands to reason, therefore, that surgical interference is seldom necessary and that the most suitable procedure for cases in which one uterine half causes trouble is hysterectomy of the faulty half. The healthy half should assuredly be left unless it is affected by malignant disease or a large fibromyoma.

I feel certain that every one will agree with me that to attempt to form a single uterus out of two halves of a uterus didelphys would be the height of surgical folly. I cannot conceive that such an operation will ever be favored.

*Uterus pseudodidelphys.* A great number of cases termed uterus didelphys are really examples of pseudodidelphys. The distinction is of importance anatomically, but clinically the two conditions are the same. The treatment of the two conditions is similar, and so I may pass on to the next group of deformities.

Cohn, Rev. de Gynéc. et de Chir. abdomén, 1909.
[1] Proc. Roy. Soc. Med., Obst. Sect., 1908, i, 41.
[2] Baillière, Tindall & Cox, 2d edit., 1911.

D. WHEN THE DEFORMITY AFFECTS THE VAGINA MORE ESPECIALLY

In many of the varieties of malformations of uterus which we have been considering, the vagina is also deformed. Thus in atresia of the cervix there is frequently a complete atresia of vagina, while in the septate and double uterus the vagina is often divided by a more or less complete septum. As regards the vaginal septum little need be said, the septum is easily dealt with and can be removed without difficulty with scissors, as I have had to do on two occasions where the septum formed an obstruction to the passage of the child. There are many cases on record where a similar proceeding was necessary.

In those cases where there is an atresia of one half and hæmatometra or hæmatocolpos, the treatment will depend on the extent of the atresia. If there is a simple membrane or diaphragm in one canal, division of it is all that is necessary; but if the atresia is extensive, removal of the corresponding uterine half will generally give the best result. The problem, therefore, resolves itself into the treatment of atresia of the vagina.

The surgical problem of pronounced atresia of the vagina has long interested operators, for the great difficulty has always been to secure a canal which would not contract and return to the condition it was in prior to operation.

Now, I think we are all agreed that the older attempts to secure a permanently patent vagina by dissection from below have generally proved unsatisfactory. The earliest operative proceeding was the attempt to establish a vagina by simple dissection. In many cases the bladder and rectum were separated and a tubular space formed, but almost invariably the canal contracted in spite of every attempt to maintain its patency by dilators.

An advance upon this simple procedure was the attempt to maintain a patent canal by grafting upon the cellular tissue portions of skin and mucous membrane from the neighborhood of the vulva. Quite a number of cases of success from these methods are recorded, especially in cases where the atresia was confined to the lower third of the vagina

and the mucous membrane of labia were employed. Other devices of employing folds of peritoneum and Thiersch grafts were less successful, while hetero-grafting of skin or mucous membrane from man and the lower animals were of experimental interest, but were never extensively employed and were almost without exception unsatisfactory.

A great advance in recent years was initiated by Pfannenstiel, who pointed out the importance of opening the abdomen and determining exactly the condition of uterus and tubes before proceeding to the construction of the vagina. In the first operation Pfannenstiel brought down the cervix to a low vaginal rudiment of about 1½ cm. in

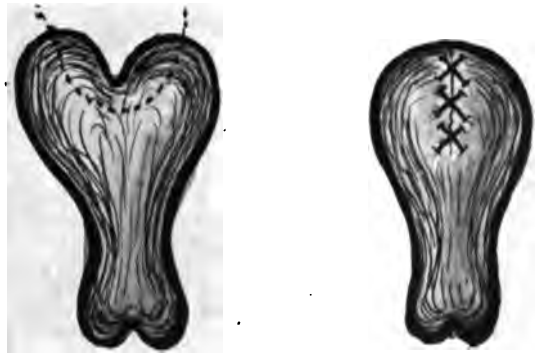


Fig. 6

depth. The canal remained patent and the women menstruated regularly.

I am not concerned here with these simple cases of atresia in which a thin membrane obstructs the canal. I propose to consider only those in which the obstructing tissue is of considerable thickness.

In dealing with such cases the operator should first open the abdomen, determine the condition of uterus and adnexa, and confirm his diagnosis of the site and extent of the vaginal atresia. Having done this the procedure to be followed will depend on the situation and extent of the obstruction.

Supposing the atresia to be in the lower part with absolutely no trace of a vaginal orifice, the operator, having emptied the hæmatometra or hæmatocolpos, should separate off the bladder as far as possible from the

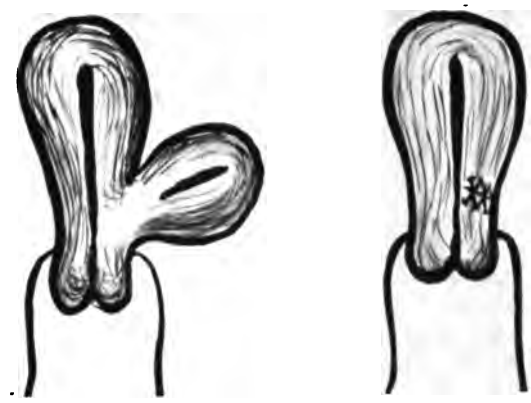


Fig. 7

abdomen and loosen the attachments of uterus and upper two-thirds of vagina rudiment. In doing this he may have to divide the uterine arteries. He should then dissect up from below and grasp the blind end of the vagina which is pushed down from above by his assistant. The vaginal sac should then be incised and stitched to the skin margin. This somewhat simplified procedure was the method employed by Pfannenstiel in a case operated upon by him in 1900 and described by Cohn.[1]

If the atresia is situated in the middle third and there exists a lower and upper vaginal rudiment, an end-to-end anastomosis of the vagina should be attempted by means of com-

[1] Zentralbl. f. Gynäk., 1908, p. 1596.

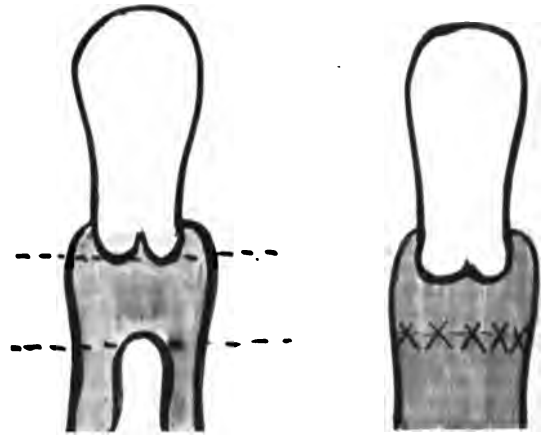


Fig. 8

bined abdominal and perineal manipulations. Should that fail, the lower rudiment must be sacrificed and the upper brought down to the skin. At first only a very shallow vagina will result, but it will deepen as the uterus is drawn upwards, as Pfannenstiel has shown. In cases where the atresia is situated in the upper part of the vagina and there is a fairly good lower rudiment, an attempt should be made to unite the cervix to the vaginal rudiment in the manner already referred to in connection with complete atresia of the cervix. Unfortunately, however, in case of this nature the cervix is often atresic and it is quite impossible to join uterus and vaginal rudiment, as was well illustrated in Cohn's case already referred to.

In cases of complete atresia with functionating uterus little can be done of a plastic nature. An extremely interesting case of this nature was one recently described by Fordyce, who ultimately found it necessary to perform hysterectomy. Had Fordyce been able to establish a communication from below it might have been possible for him to pull down the uterus and stitch it to the skin. An important point in connection with this case was the fact that Fordyce found it difficult to perform hysterectomy until he had emptied the distended uterus. I believe this is a matter of the very greatest importance in these cases if one is going to attempt any plastic operation. I should very much like to encounter a similar case. I feel certain that it is quite possible after constructing a vagina by Baldwin's or Sneguireff's method to open the abdomen again some weeks later and establish a permanent communication between uterus and artificial vagina.

This would be preferable to establishing the continuity of the new uterovaginal canal at one and the same time.

This naturally brings me to the consideration of the most recent gynecological procedure, constructing a vagina from a portion of isolated bowel.

The justification for doing this major operation, for it must be considered a major operation, is a matter of opinion, especially in those cases where there is a rudimentary non-functionating uterus; when, in other words, the artificial vagina is constructed solely for the purpose of intercourse. The morality of the question I am not going to discuss: I am simply going to put on record a case in which I performed Baldwin's operation and in which I considered I was justified in so doing. I may say I performed the operation in the University Gynecological Department of the Royal Infirmary before the Visiting Gynecological Society when they visited Glasgow in November of last year.

The woman was thirty years of age and married. She was physically well developed to all appearance. She was of normal height, well nourished, had well developed mammæ and vulva. There was, however, only the shallowest dipple marking the vaginal entrance. I detected by a recto-abdominal examination made under anæsthesia that there were two movable bodies (ovaries) placed close up against the pelvic brim. I could find no trace of a uterus. She had no discomforts in the way of menstrual molimen, abdominal pain or headache; indeed, she enjoyed perfect health. She informed me, however, that her husband threatened divorce. I explained to her the operation which I ultimately performed, and she decided to have it done. The operation was performed as follows: I opened the abdomen and isolated the most dependent loop of ileum. It was situated about a foot from the ileocæcal valve. Having done this and closed up the ends of the isolated loop, I established a lateral anastomosis between the ileum and cæcum. I now turned my attention to the perineum and dissected up between bladder and rectum. This was a matter of considerable difficulty as there seemed to be singularly little loose cellular tissue between these two viscus. Ultimately I established an opening into the peritoneum and pulled down the loop of isolated bowel. I tried to bring one end down but found that impossible, although I now believe with proper snipping of the mesentery it might not be so very difficult. I had, therefore, to bring down the loops doubled up. I then stitched it to the margin of the perineal wound. Two or three days later I opened into the lumen of the bowel.

The patient made an excellent recovery and some months after the vagina was of good depth and admitted one finger. I have not seen her for three months. She did not complain of any mucous discharge.

The operation performed was first demonstrated by Baldwin in 1904.

Phillips of Sheffield and Victor Bonney of London have performed the operation, while on the Continent and in America quite a number have been done.

Those interested in the matter will find

the subject very fully gone into by Marshall[1], Quénu and Schwartz[2], and Kroemer[3].

The other method of Sneguireff and Schubert of making use of a portion of pelvic colon I have no experience of, but it is also referred to in some detail in the papers mentioned.

[1] Tr. Edinburgh Obst. Soc., xxxvii. 224.
[1] J. Obst. & Gynec., Brit. Emp., April, 1913.
[2] Rev. de Chir., June, 1913.
[3] Prakt. Ergeb. d. Geb. u. Gyn., Heft 1, 1912.

You naturally ask what is my attitude towards these operations. At present it is as follows:

1. The operations are justifiable with a functionating uterus, for the only alternative is hysterectomy.

2. They are not justifiable in an unmarried woman with a non-functionating uterus.

3. They are sometimes justifiable in a married woman with a non-functionating uterus.

# DEPARTMENT OF TECHNIQUE

## A METHOD OF EXPOSING THE PELVIC PORTION OF THE URETER

By JOHN M. BIRNIE, M. D., Springfield, Massachusetts

THE method of exposing the pelvic portion of the ureter which is herein described may not be new, but up to the time that I conceived the idea, I had never seen or heard of it, nor could I find any description of the method, which is as follows:

With the patient in the Trendelenburg position a median incision is made beginning close to the pubic bone and extending upward, exposing the space of Retzius in the usual manner. No muscle fibers are cut but the recti are retracted to either side. The point where the parietal peritoneum is reflected onto the bladder is noted and care taken not to open the peritoneal cavity. Starting at the bladder, the peritoneum is wiped away toward the median line separating it from the bladder and pelvic wall, thus exposing the ureter. With retraction one gets a complete exposure of the ureter and any necessary procedures may be carried out under the guidance of the eye. Drainage, if necessary, may be instituted through the original incision or through a separate stab wound.

Since first employing this operation, several months ago, I have not had a chance to try it again, but, at my suggestion, three of my colleagues at the Springfield Hospital have employed it with complete satisfaction.

## TECHNIQUE EMPLOYED IN EXCISION OF A CARCINOMATOUS URETHRA

By SIGMAR STARK, M. D., Cincinnati
Professor of Clinical Gynecology, Medical Department, University of Cincinnati; Gynecologist, Cincinnati General Hospital; Gynecologist, Jewish Hospital

ON December 3d I operated upon a woman fifty years of age in my service at the Cincinnati General Hospital.

The clinical history of the case was as follows: For a period of about one year she had been experiencing increasing difficulty, with pains on urinating. At no time was there either a purulent or bloody discharge from the urethra. About five weeks previous to the operation she noticed a "lump" in the anterior vaginal wall corresponding to the site of the urethra which rapidly grew in size and was associated with great difficulty in voiding urine.

On examination a diffuse infiltration, involving the whole urethral canal about 2½ cm. in width and extending up to the pubic arch, was encountered. "Milking" of the urethra was not followed by a discharge from the meatus. A small probe was passed with great difficulty into the bladder. The inguinal glands of both sides were only moderately enlarged. A diagnosis of periurethral carcinoma was made, which was confirmed by Dr. Paul Wooley, pathologist to the Cincinnati Hospital, who pronounced the same to be an epithelioma, by examination of a section removed under cocaine.

The surgical technique employed was as follows: A curved incision about 4 cm. in length was made directly under the arch of the pubes and continued in depth through the triangular ligament until the retropubic space was reached. From this a longitudinal incision through the vaginal wall was then made on either side of the indurated area in a posterior direction well beyond the limitation of the involved tissues. The two vaginal flaps were then deflected by dissection laterally toward the ischiopubic rami. Curved hæmostats were then placed from above downward on the tissues before they were cut through first on one side and then on the other close to the lateral wall of the pelvis, as far backward as seemed necessary. The object of this was to anticipate hæmorrhage from the branches of the internal pudic vessels coursing through the triangular ligament. This precautionary measure turned out very satisfactorily as the bleeding was almost nil. After liberation of the tumor mass, it was incised along its whole anterior surface into the urethral canal and bladder. This procedure facilitated the final removal of the remainder of the tumor through a healthy zone under ocular supervision, which disclosed the fact that the part of the bladder wall immediately surrounding the internal urethral orifice had been excised. After ligation of the vessels included in the curved hæmostats by transfixion,

the bladder orifice was sutured to the vaginal wall in such a manner as to leave an opening only large enough to admit the introduction of a No. 10 soft rubber catheter. Anterior to the vesicovaginal opening the vaginal flaps were brought together in the median line by chromic acid catgut suture, leaving a space under the pubic arch for drainage of the rather large retropubic cavity. A soft rubber catheter was fixed in the bladder by suture to the vagina for continuous drainage. The inguinal glands of both sides were likewise excised.

After three days the catheter was removed and to my surprise the patient had fairly good control of her urine, which was continuous until she got up on the ninth day. Since then the condition is this—she can hold her urine while in bed and has fair control when up, that is, there is no continuous incontinence, but when the desire to pass urine comes on she must void it at once.

I have been prompted to report this case because of the difficulty I experienced, in looking up the literature of the subject, in finding any detailed description of the surgical manner of dealing with this condition. The technique practiced was evolved by myself and is seemingly correct in principle.

---

# A SIMPLE HEAT METHOD OF STERILIZING AND STORING CATGUT

## After Ten Years' Use of It

By WILLARD BARTLETT, A. M., M. D., Saint Louis

AFTER years of experimentation with absorbable materials, the author began, early in 1904, to employ regularly the method of preparing catgut which was embodied in a preliminary report published in the *Interstate Medical Journal* of March, 1905. The Mayo Clinic was the first of the many large institutions to adopt and use it as a routine procedure. During the nine years which have just passed, gut prepared in this way has been used at Rochester with satisfaction in more than sixty-three thousand operations. This is perhaps the most eloquent testimonial that could be accorded the practical worth of a hospital method and makes it unnecessary to detail the many and crucial bacteriologic checks which have been employed.

The real object of this writing is not only to set forth the small refinements which have crept into the method during the ten years of its employment by me, but at the same time to render impossible in other hands the occasional errors in technique which have resulted from lack of detail in my early published directions. Frequent requests for information make my duty in this direction obvious.

The process is to be divided into these definite steps: *drying*, *sterilization* and *storage*.

1. The ordinary commercial ten-foot catgut strand is divided into four equal lengths, each of which is made into a coil about the diameter of a silver quarter. By twisting the last free end three or four times around the components of this little coil the latter is enabled to maintain its shape. These coils are then strung like beads upon a thread so that any desired number can be conveniently handled by simply grasping the thread.

2. The string of catgut coils is dried in a bacteriologist's dry sterilizer for four successive hours at a temperature of 80 degrees, 90 degrees, 100 degrees, and 110 degrees centigrade. Let thin gauze be interposed between catgut and metal. This should not be attempted on a *damp day* or in a *room which steam enters*.

3. The catgut is immediately placed in liquid albolene (petrolatum liquidium) where it is allowed to remain until perfectly "clear" in the sense that the term is used in the preparation of histological specimens. This is usually accomplished in a few hours, though it has been my custom to allow the gut to remain in the oil over night. Thin paper must line the receptacle so that the catgut may not touch its walls.

4. The vessel containing the oil is placed upon a pan of sand and the temperature raised by a gas-flame during one hour to 160 degrees centigrade, which temperature is maintained for a second hour.

5. By seizing the thread with a sterile forceps the gut is lifted out of the oil, an excess of which is allowed to drip off, the thread is cut and the coils dropped into a solution of iodine crystals in Columbian spirits (deodorized methyl alcohol), the proportion of iodine varying according to the diameter of the catgut. For No. 00 it should be 1 to 700; for No. 0, 1 to 600; for No. 1, 1 to 500; for No. 2, 1 to 400; for No. 3, 1 to 300; for No. 4, 1 to 200; the iodine being taken by weight and the alcohol by volume. The material becomes

ready for use in a few hours, and should remain in the solution indefinitely without deterioration. A few coils may be removed at any time with no risk of contaminating those left behind.

Although I should be far from adopting a surgical procedure simply because it is economical, it will strike anyone that the chemicals here used are very cheap. Furthermore, the liquid albolene can be used repeatedly in spite of its color growing darker with reheating.

It seems to me important that the gut should be thoroughly "cleared" before the oil is heated, in order that we may thus be certain that the temperature at the center of the strand becomes as high as that of the oil surrounding it.

It may be noted that I do not remove the oil from the gut before placing it in the storing solution. This is avoided purposely, since catgut which is perfectly free from oil is so very sensitive to the action of water that it readily untwists and becomes tangled after it has been used in a wound but a few moments. This storing fluid simply takes off enough oil from the exterior of the strand so that it is not too slippery for use, and the albolene, being a bland, non-irritating substance, can safely be introduced into the tissues.

The iodine rapidly permeates the strand, which will be found stained brown after a few hours, assuring the surgeon that he is introducing an antiseptic as well as a thoroughly sterile suture material and one which is readily seen in the field of operation.

As far as the tensile strength, the elasticity, and the pliability of this finished product are concerned, I may state that these leave nothing to be desired.

I have made a large number of breaking tests, and have found no other heat method to produce a stronger strand.

Catgut treated in this way lasts in the tissues somewhat longer than the same size strand of *plain* gut treated by most of the other methods in vogue at the present time.

I have found that the material so treated deteriorates not at all with age, neither as far as strength nor sterility is concerned.

The physical qualities of the finished strand will astonish the surgeon who uses it for the first time. I am very certain that a blind man used to handling catgut prepared by other methods would not recognize this product as catgut at all if it were placed in his sensitive hands.

---

# A NEW OPERATIVE PROCEDURE FOR THE TREATMENT OF SUPPURATIVE SALPINGITIS IN YOUNG WOMEN

By W. BLAIR BELL, B. S., M. D., Liverpool, England

FOR the treatment of bilateral pyosalpinges in young women one of the following operative procedures is usually adopted:

1. Bilateral salpingectomy by ligature.

2. Bilateral salpingectomy, with excision of the uterine ends of the tubes.

3. Bilateral salpingectomy, by one of the above methods, with unilateral or bilateral oöphorectomy.

4. Bilateral salpingectomy, by one of the above methods, and hysterectomy (subtotal or total) with or without unilateral or bilateral oöphorectomy.

I have myself always held the opinion, which is based on experimental[1] and clinical observation,[2] that complete bilateral öophorectomy in young women is an unscientific and unjustifiable procedure in the absence of malignant disease, of bilateral innocent tumors, or of bilateral ovarian abscesses.

It is, however, impossible here to enter into a discussion of this subject. It is one about which diametrically opposed views are held. The reasons for my own are set out in the communications referred to[1,2]. Let me state, therefore, at the commencement that the justification for and desirability of the procedure I have devised, and shall describe presently, depend to a large extent on the belief that the internal secretions of the gonads and the existence of the menstrual function are of considerable benefit, both physical and psychical, to the young adult female.

That is the first important point, and it is a physiological one.

Next, with regard to the pathological aspect of the procedure, it is well known that with ascending tubal infections the fundus of the

[1] Bell, W. Blair: "The genital functions of the ductless glands," Arris & Gale Lectures, Roy. Coll. Surg. Eng., Lancet, 1913, March 22 and April 5.

[2] Idem, Introduction to a discussion on "The relation of the internal secretions to the female characteristics and functions in health and disease." Proc. Roy. Soc. Med., 1913, vii.

uterus, as well as the cervix in gonorrhœal conditions, is involved (Fig. 1). As a clinical result of infection of the body of the uterus we frequently see very severe menorrhagia and sometimes leucorrhœa persist after bilateral salpingectomy. Consequently it is advisable to adopt some procedure which will take into account the infection of the body of the uterus. Hence the pathological indications are no less important than the physiological.

My method of procedure meets both the physiological and pathological requirements described above.

It aims at removing diseased structures as widely as possible, while one ovary, or a portion of it, is preserved, together with sufficient endometrium to ensure the subsequent occurrence of regular menstruation.

In other words, both tubes, one ovary, and a wedge-shaped portion of the fundus uteri are removed.

The following are the steps of the operation:

1. The abdomen is opened in the usual way by a median subumbilical incision.

2. All superficial adhesions of omentum or bowel are put upon the stretch, ligated when necessary and cut through.

3. The intestines are then carefully packed off with the thin rubber pack which I have used for some years. Gauze can subsequently be introduced against the rubber pack if necessary.

4. The tubes and uterus are next completely freed, and pus in the pelvis is carefully mopped up as it is seen.

5. The patient is now lowered into the Trendelenburg position.

6. The uterus is raised by means of a volsellum attached to the fundus, and the operator proceeds to remove the tubes, fundus uteri and one ovary in the following manner. (The steps are described for the operator, who stands, as the writer does, on the *left* side of the patient, placed in the Trendelenburg position.)

(*a*) The free edge of the mesosalpinx on the right side is seized with a pair of long compression forceps. The edge of the mesosalpinx is divided between the attachment of the forceps and the tube, which is held with another pair of compression forceps, and the mesosalpinx is cut through up to the uterine attachment of the tube. One or two bleeding vessels require to be caught in compression forceps and ligated. Likewise the free edge of the mesosalpinx is tied and the forceps are removed.

(*b*) The ovary and tube on the left side are next freed in a similar manner, except for the modifications needed by the removal of the ovary. The infundibulopelvic ligament is caught in two pairs of compression forceps and divided between them. The broad ligament just below the junction of the mesosalpinx and meso-ovarium is now cut through with scissors up to the uterus, and the bleeding vessels are caught as they are divided. If the curve of the junction of meso-ovarium and mesosalpinx be followed the section of the broad ligament will end just below the insertion of the tube and the attachment of the ovarian ligament. The severed vessels are tied.

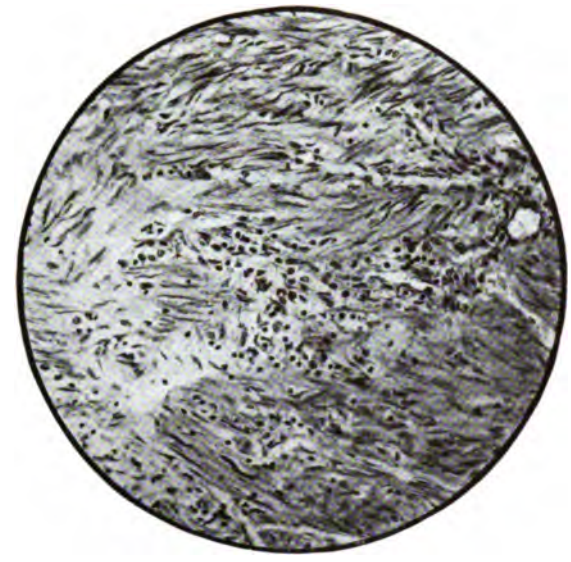


Fig. 1. Infection of the fundus uteri. From a case of suppurative salpingitis.

Note the round-cell invasion of the musculature, proceeding from a small thin walled vessel on the left of the section x 200.

(*c*) A superficial incision is made from about half an inch below the insertion of the right tube across the front of the fundus of the uterus through the round ligaments, which are caught in compression forceps and tied, to a similar point on the opposite side. Another incision is then made between the same two points across the fundus posteriorly. The portion of fundus uteri thus marked out is removed by deepening the incisions downwards and inwards so that a wedge-shaped excision of the fundus is carried out (Fig. 2). The ascending uterine arteries on each side will be cut through in the final separation of the portion excised. They should be caught as they are cut, and ligated after the fundus has been removed.

(*d*) The large deep wedge-shaped wound in

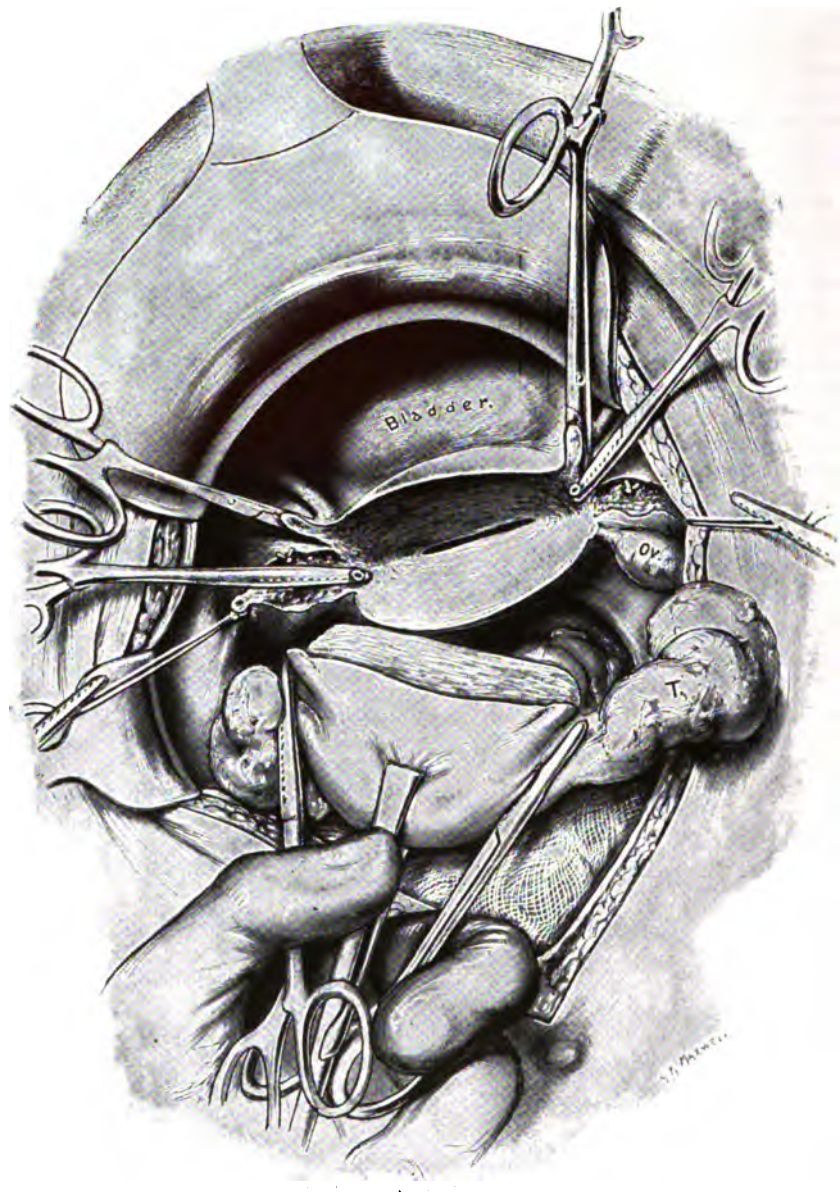



Fig. 2. Illustration of operation. The operation at the stage when the diseased parts have just been completely excised and are ready for removal. They are left *in situ* to show the relation of the parts removed to the remaining structures. (From Burghard's System of Operative Surgery.)

the uterus is partially closed by the insertion of four deeply placed mattress sutures which pass through both flaps.

(*e*) The edges of the right mesosalpinx are sewn together with a running suture, and all ligated points are covered with peritoneum. The running suture is continued over the summit of the stump of the uterus, in order to coapt with peritoneal surfaces of the flaps. The suture is then carried on to close the two peritoneal surfaces of the divided broad ligament on the left side. Care is taken to bury the ligated stump of the infundibulopelvic ligament between the two layers of peritoneum.

(*f*) The cut ends of the round ligaments are now sewn to the uterine stump on each side.

(*g*) The right ovarian ligament is also sewn to the right side of the uterine stump, and, if necessary, the free edge of the meso-ovarium is attached to the round ligament of the same side to prevent prolapse of the ovary.

7. Finally the abdominal incision is closed in the manner adopted by the individual operator.

In my hands the operation has proved most satisfactory. All symptoms have been removed and the patients have in all cases — except the last one operated upon quite recently — menstruated regularly and painlessly and to a moderate extent.

Since I devised this operation some eighteen months ago I have not had a sufficient number of cases nor are the after-histories long enough to report on at present, but this essential information will be given in due course.

Before closing this paper it is necessary that I should call attention to a brief statement in the Lancet,[1] which reported the International Congress last August, to the effect that Professor Beuttner of Geneva had made a communication concerning an operation which, so far as I can I gather from the brief statement made, corresponds with mine. I was not in London when the communication was made nor have I yet had an opportunity of reading an account of Professor Beuttner's technique. Before any mention of his procedure had been made I had contributed an account of my operation to the forthcoming edition of Burghard's Operative Surgery. Naturally, too, I had been performing the operation long before I wrote any account of it.

[1] Lancet, Lond., 1913, August 16, p. 483, and August 23, p. 597.

---

# A PRELIMINARY REPORT ON THE TREATMENT OF FRACTURES BY FIXATION WITH ANIMAL BONE PLATES AND BONE SCREWS[2]

By E. J. BROUGHAM, M. D., and A. C. ECKE, M. D., Chicago

FIXATION devices consisting of bone, human or animal, and ivory, are not new: their technique simply varies. All the methods have their origin in the effort to procure the use of probable absorbable material, and so dispense with the metallic fixation material, which frequently causes a good deal of trouble.

The ideal fixation for fractures is undoubtedly the intramedullary autograft, but the technique is not so simple, and the procedure requires really two operations.

Magnuson's ivory plates countersunk into the fractured bones and transfixed with ivory screws is an admirable attempt to use absorbable material, but again, his technique is not simple.

Our procedure gives efficient fixation and the technique is as mechanically simple as that of the Lane plate, and requires no complicated tools. The material is bone from government inspected cattle. The bone comes to the market bleached, deprived of its animal matter, and in dry form.

The working set of bone plates (Fig. 1) is five in number, Plate No. 1 being the smallest and Plate No. 5 being the largest. They are all of equal thickness, about one-eighth of an inch, and according to standard gauge No. 9. The plates differ in their length and width, and the number of threaded holes in each plate. They are concave on the under surface. The tops are plain, with slightly rounded ends and edges.

The complete set is received by the surgeon already drilled and threaded. They are thoroughly scrubbed with hot water, soap and brush, rinsed and sterilized by boiling for two hours and placed in formalized alcohol; shortly before using they are put in normal salt solution. Neither the boiling nor the antiseptics injure the plate or the trueness of the threads.

The size of the threads are twenty to the inch, and are fashioned with a 12x20 standard steel tap, which signifies twelve gauge drill with which the holes are drilled, and corresponding to the thread turned upon the bone screws. The purpose of the greater number of holes in the larger plates is to accommodate, if occasion requires. Plates may be sawed off and made shorter. The remaining holes not needed serve as drainage. The entire set of five plates with screws are sterilized and made ready for the operation. The surgeon selects from the lot the plate best suited to the fracture he desires to fix.

After bringing the ends in apposition and holding the same firmly in place with a pair of forceps he places the plate in the wound over the fracture.

[2] Read before Chicago Surgical Society, March 6, 1914.

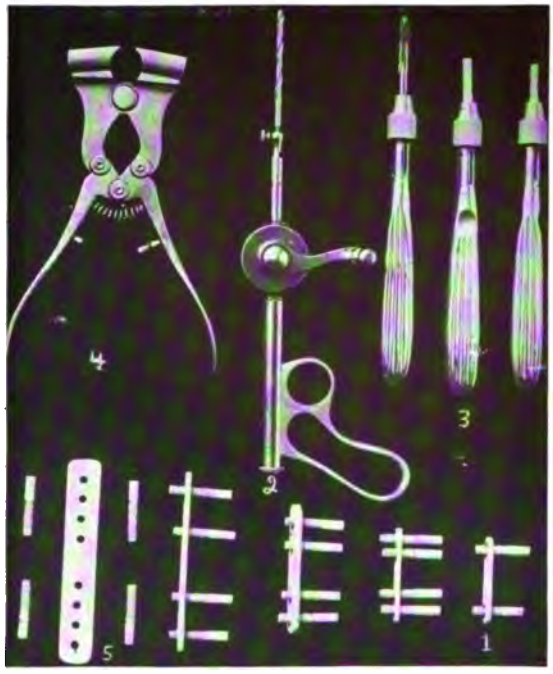



Fig. 1.

The plate is held from slipping by an assistant, with long tissue forceps pressing upon it. Next, a Richter brace (2) previously mounted with the twelve-gauge spiral drill, is used to drill the fractured bone at each end, care being taken not to go deeper than is needed—just through the cortex, and not the medulla. Next, the steel tap previously mounted in a long-handled chuck (3) is carefully turned through the already made thread in the plate, and on into the bone, turning it backward to ease it and prevent binding, and turning it ahead to fashion the thread in the underlying fractured bone. Next, the long-handled holding chuck, with the bone screw previously mounted, is taken up and the screw is turned carefully and securely through the plate, and through the cortex of the underlying fractured bone; after testing its firmness by a gentle upward traction on the chuck, the screw is in place; with a pair of forceps, loosen the grasp of the chuck on the bone screw and remove the holding chuck, leaving the bone screw with the part held by the chuck projecting upwards.

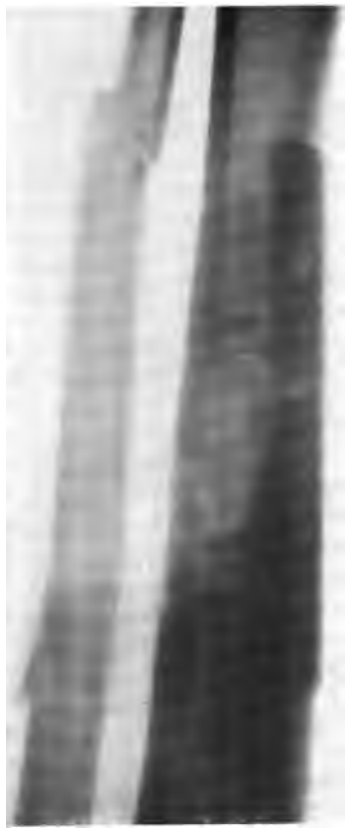
The empty holding chuck is then refilled by assistant. We have two holding chucks to facilitate the placing of screws. Next, the bone is again drilled through the hole at the other extremity of the plate, the tap introduced, the bone screw placed in the same manner, and the plate thus secured. Next, the intermediate holes are drilled and the bone screws placed. Usually four are put in. The projecting bone screws above the bone plate may be clipped off after each bone screw is placed, and before proceeding with another; or they may all be placed, and then sawed off with a small metacarpal saw. In using our special bone clipper (4) for clipping off the projecting bone screws, each screw must be clipped off when it is placed to make room to adapt the clipper accurately to the screw to be clipped off. This instrument is a compound lever clipper, and very powerful, and if not held free and in accurate position may damage the bone screw.

The entire operation is conducted according to the technique of Lane of London. Towels are clamped to the edges of the wound. All the suture material, needles, gauze, sponges, plates, screws, drills, and everything used to carry on the operation must be handled with steel instruments.

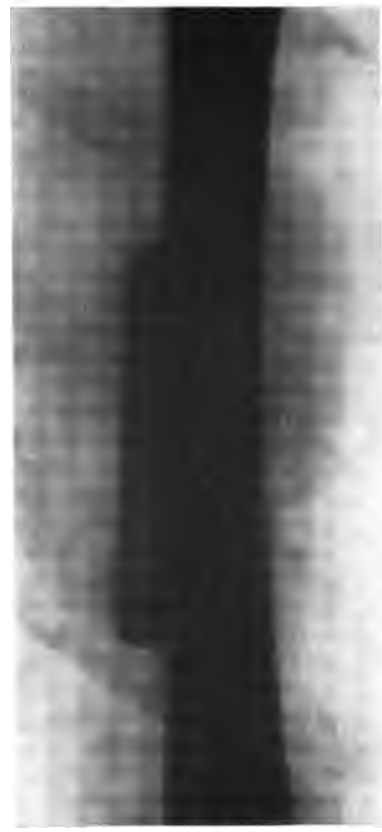
After wound is sutured, dressings and cast are applied. When one or more plates have been used from the set they may be ordered singly, and the working set thereby kept complete. The stock material from which the bone pates are made are of sufficient bulk to permit much heavier and much larger plates and screws if it were desired, but keeping in mind the absorption of the plates we made these as light as consistent with strength.

The other instruments used are the usual bone plating instruments familiar to surgeons. We recommend and have used satisfactorily Lane forceps, Lane elevator skid, and Richter brace. The bone plates have been used in the following three cases.

CASE 1. W. P. R., male, aged 51 years; working in a meat market, August 2, 1913. While attempting to lift and turn around a quarter of beef same slipped from his grasp and slid on to his left thigh. With renewed effort and exertion of muscles and thigh he succeeded in placing it back upon the hook. Patient began to suffer pains in the upper thigh but kept at work and hobbled about with aid of a cane for a period of three weeks, when his left side suddenly weakened and let him down on the ground. He was unable to walk, and was conveyed to his home. Three days later he was admitted to the Passavant Hospital. Examination showed marked swelling of the left upper thigh anteriorly and laterally. X-ray showed an oblique subtrochanteric fracture. The fracture was treated for eight weeks by extension, counterextension and a long side splint. At the end of this time there seemed to be no callus, thigh angling, and shortening of an inch and a half when relieved of extension weights. We decided to plate the femur. At operation no callus was found. The ends of the fractured bones were cleansed and thoroughly curetted; the fracture reduced and a bone plate three inches long with four screw holes applied. There was a



Case 2. Male, age 23, showing bone plate and fracture eight weeks after plating. Patient about in ten weeks.



Case 3. Male, age 8 years. Bone plate in position day after operation.

good deal of difficulty to get room for upper end of plate because of trochanter, and only one screw could be placed here. The bone was very soft. Wound closed with silkworm sutures, dressing and plaster cast applied. Patient returned to bed. No extension. Cast remained for four and a half weeks; being soiled and softened was removed. Dressing showed a moderate amount of oozing; sutures were taken out, dressing applied. Examination showed no angling or shortening. Another cast was put on and left four weeks. At its removal the limb was X-rayed, showing plate in good position. Palpation showed a large amount of callus. Patient was able to elevate thigh, abduct and adduct same. Callus was not sufficiently ossified at the time, and the patient attempted to bear his weight on the limb causing callus to yield. X-ray showed lower end of plate slightly lifted, allowing slight angling. Thereupon cast was reapplied and remained six weeks. Ten days after its removal, patient was allowed to be about with aid of crutches.

We are satisfied the plate held and served its purpose sufficiently long for a normal fracture to unite, and it even stimulated callus formation in our opinion.

CASE 2. Y. M., male, aged 23 years; laborer for construction company. He was injured by a roof collapsing and falling upon him while wrecking a building; was standing on an elevation about five feet from the ground; was thrown and pinned under fallen roof. He was admitted to Passavant Hospital the day of his accident, December 3, 1913.

Examination showed five fractures of the left leg, two of the femur, one of the tibia, and two of the fibula. The fracture of tibia was compound, of oblique type, upper fragment projecting through wound and foot dangling. This fracture was plated immediately with the bone plate and four screws. The plate contained six holes, the two unused holes serving for drainage. The wound was closed with a small strip of gauze for drainage; dressing and cast applied up to knee, and leg put on double incline plane for the femur fractures.

Cast was fenestrated ten days later, drain and stitches removed, and wound comparatively dry. Cast was removed after three weeks. Second cast applied and left for five weeks; after its removal patient remained on incline plane for a week longer. He was then allowed to be up and about with crutches. A week later was walking with aid of cane. X-ray (Fig. 2) showed plate in position and tibia in good line, also loose piece of fibula well mortised.

CASE 3. Wm. B., male, aged 8 years; was admitted to Passavant Hospital January 30, 1914, to the service of Dr. M. L. Harris. He had been injured by being knocked down by a passing automobile. Examination showed fracture about middle of left femur. Repeated attempts at closed reduction not being satisfactory, February 13th,

two weeks after his admission, case was plated by Dr. Harris with the bone plate and four bone screws. Operation disclosed separation of fractured end with muscle tissue interposed. Fracture was of the transverse type, with a V-shaped portion of lower fragment about three-eighths of an inch in widest measurement wanting. Harris wire suture used for closing wound, and cast applied. Patient put to bed, no extension. X-ray following day showed plate in position and perfect apposition of fractured ends. Cast fenestrated February 24th, wound dry, wire suture removed, reinforced cast without removal. X-ray at this time, twelve days after plating, perfect; apposition of fracture and bone plate in position.

The cast was removed five and a half weeks from date of operation. Patient returned to bed, no cast applied. Examination shows solid union, large callus, no shortening; perfect results. Final X-ray (Fig. 3) showed bone plate in position, perfect alignment of fracture.

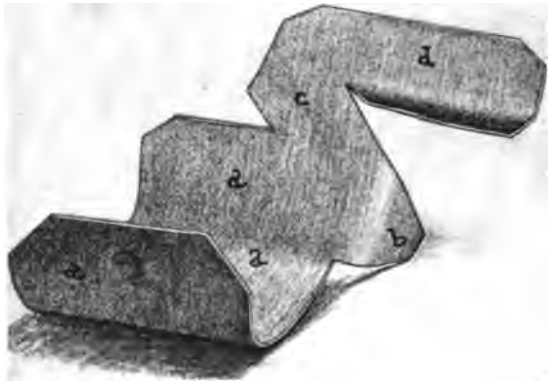
---

# THE TREATMENT OF A CASE OF BIRTH FRACTURE OF THE SHAFT OF THE FEMUR

By VILRAY P. BLAIR, A. M., M. D., F. A. C. S., Saint Louis, Missouri

IN the case of a large infant in a breech presentation the shaft of the left femur had suffered a transverse fracture; considerable angling resulting. This was to me a new condition and its treatment presented several special problems.

First, the very meager circulation of the lower limb must not be impeded by tight bandages, nor do I believe the skin would tolerate adhesive plaster. Second, the ordinary care of a newborn infant, bathing, nursing, etc., must not be




interfered with. Last, the injured bone should be maintained in its proper outline while healing occurs. These indications were met by the splint shown in the illustration.

A pasteboard pattern was first made, and from it a splint of galvanized steel was cut. The steel was of the weight used for house gutters and down spouts. The body portion (*a*) reached from the greater trochanter of the femur to the axilla, and enveloped the back and both sides fairly closely. The small buttress (*b*) maintained the stability of the body portion by resting squarely on the bed or table. The thigh portion (*c*) corresponded with the normal position of a baby's thigh when it is crying and thereby straining. The leg part of the splint (*d*) was longer than the infant's leg and its lower border was bent mesially to form a small shelf.

This splint was heavily padded. The baby was laid in the body position, resting there simply by its weight; while the thigh and leg, after being covered with cotton, were bandaged to the splint. The napkin was not placed on the child in the ordinary manner, but was folded in several thicknesses, and simply laid under the buttocks, the upper border of this pad extending up between the splint and the nates.

This splint was entirely removed and reapplied every day at the time the child was bathed and powdered, the injured limb being held in the proper position by the aid of a second person. After the first few days the application of the splint was done entirely by the nurse. The baby nursed and apparently suffered no discomfort from the splint.

In the first attempt at making the splint, the part for the lower limb was made vertical and the leg and thigh bandaged loosely to it. This proved ineffective and also the very loose bandaging over cotton seriously impeded the circulation. The splint was then bent to a right angle at the knee. This was an improvement, but there was a forward angling of the shaft when the child cried, so a new splint cut on the lines shown seemed to overcome these difficulties.

There was firm union in excellent position in four weeks.

# PERSONAL EXPERIENCES WITH COAGULÈNE-KOCHER-FONIO

## A Critique of Twenty Cases in which the Preparation was Used

By GEORGE DE TARNOWSKY, M. D., Chicago
Attending Surgeon, Cook County and Ravenswood Hospitals

WHILE on a recent visit to Kocher's clinic in Berne, my attention was called to a new method of checking hæmorrhage in the course of surgical operations. Doctor Anton Fonio, first assistant to Professor Kocher, who elaborated the preparation, published his first report of seventy-five cases (December, 1912, to March, 1913) in the Correspondenz-Blatt für schweizer Aerzte (1), and I have made free use of his article in the preparation of this report. Dr. Fonio began his study of the subject in 1909 (2), Professor Kocher having requested him to evolve a practical thrombin for clinical purposes. Kocher himself had for several years successfully made use of pieces of fresh muscle-tissue applied to oozing surfaces in brain operations. The monographs of Bordet (3), Nolf (4), Sahli (5), Lilienfeld (6), Fuld (7), Zak (8), and of Bordet and Delange (9 and 10), should be freely consulted in order to obtain a detailed account of the various theories of blood coagulation.

In view of the many conflicting opinions expressed, it seems probable that in the process of blood-coagulation two or three "mother-substances" contribute, either equally or in a varying degree, to the reaction, thus allowing the active coagulation agent to develop. The presence of calcium salts is necessary for the complete reaction. The following tabulated grouping of the newest theories of coagulation is taken from Fonio's original article:

A. Schmidt: Prothrombin+zymoplastic substance=thrombin (fibrin-ferment)
Lilienfeld: Leuconuclein+fibrinogen=thrombosin+calcium=fibrin+fibrin-ferment (soluble globulin)
Arthus and Paget: Fibrin-ferment+calcium+fibrinogen=fibrin+globulin (soluble)
Morawitz: Thrombokinase+thrombogen=a prothrombin+(b prothrombin)+calcium=thrombin (fibrin-ferment)
Fuld: Cytozym+plasmozym+calcium=holozym (active ferment)
Nolf: Thrombozym+thrombogen+fibrinogen+calcium=fibrin+thrombin (soluble)
Bordet and Delange: Cytozym+serozym+calcium=thrombin (active agent)=fibrin.

With these several theories as a working basis, Fonio sought to isolate one of the active coagulating elements of the blood in such a manner and quantity as to make its everyday usage practicable. It had been known for some time that Bizzozero's blood-platelets were of a lighter specific gravity than either the erythrocytes or leucocytes, but Morawitz (10) was the first to isolate them through fractional centrifugation. Bordet and others had also shown that the blood-platelets could stand a temperature of 100° C. for several minutes without losing their activity. Their rôle in blood coagulation was also well known. Bürker (11) and others were able to arrest coagulation by preventing the disintegration of the platelets; it is, therefore, believed that, in this process of disintegration, a substance is liberated which brings about the ferment-like elaboration of fibrin. Fonio is of the opinion that the platelets constitute the only element in the blood which furnishes thrombozym, but this belief is not universally accepted. In order to obtain blood-platelets, many technical difficulties had to be surmounted. The process of separating these elements can never be an easy one as their chief characteristics are their viscosity and vulnerability. Through fractional centrifugation of mammalian blood Fonio succeeded in obtaining platelets free from all other blood elements.

The details of this process have not yet been published. A cell-free preparation of thrombozym was obtained by extraction which was sterilized by heating to 100° C. for fifteen minutes and then placed in ampoules ready for use. To this preparation, which intensifies and accelerates coagulation both *in vitro* and in the living, the name of Coagulène-Kocher-Fonio was given. It retains its activity after heating to 98° C. for fifteen minutes, and is soluble in alcohol, chloroform, water, normal salt solution, etc. As prepared at present for commercial purposes (through the courtesy of Dr. Fonio I was able to obtain fifty grams of the powdered preparation from the "Gesellschaft für Chemische Industrie" in Basel, Switzerland), it comes in the form of a granular substance having a sugar basis, and is simply dissolved in sterile water and boiled for five minutes. The strength of this solution, as recommended by Fonio, is either five or ten per cent. Once dissolved, the preparation must be used within twenty-four hours as it rapidly loses its activity.

In a large series of tests *in vitro*, Fonio con-

clusively proved that animal coagulène hastens the process of coagulation at all stages, and that, once coagulation begins, it rapidly becomes complete. He found on the contrary that human coagulène only hastened the end-process of coagulation, it having no effect on the initial stage. The effect of coagulène on fresh wound surfaces was found to be more rapid than *in vitro*.

*Technique.* One gram of coagulène is dissolved in 20 ccm. of sterile water and boiled for five minutes. The solution can be sterilized in the autoclave, but it has seemed simpler to me to place the liquid in a glass container (an ordinary Mason jar answers the purpose very well) which is partially immersed in boiling water. Both the solution and the jar must of course be warm before plunging the latter in boiling water. It will be noticed that the fluid is slightly turbid, containing small undissolved particles. It is not necessary, however, to filter, even for intravenous injection. Aspirate the coagulène in a syringe and place it on the instrument tray, ready for use. Having made the skin incision, clamp or compress the larger blood-vessels momentarily, then apply a few drops of coagulène and wait until coagulation has occurred before proceeding. Experience has shown that the thrombus in the larger blood-vessels may not hold; therefore, it is preferable to ligate them immediately. The incision is then continued through the deeper tissues, coagulène being instilled whenever needed. Two very important postulates must be remembered: the first is that coagulène must be applied at the very site of the bleeding, on the oozing surfaces of the wound; the second is that the coagulum, once formed, must not be wiped off, by sponges or otherwise, because in so doing the small thrombi are pulled out of the vessels and the bleeding reappears.

The only action of coagulène is to accelerate and intensify the normal process of thrombus formation. Crushing of the larger arteries by means of hæmostats assists in the thrombus formation; adrenalin may also be used to reinforce the action of coagulène by its vasoconstrictor effect. In laparotomies, the most important field of usefulness has seemed to be in those cases requiring the freeing of adhesions, old or recent. In this type of case, coagulène is an ideal substitute for the hot laparotomy pad or tamponade. A few drops of the solution applied directly to the oozing surface will enable the surgeon to continue his work unhampered by gauze pads or repeated and annoying sponging by his assistants. In the closing of laparotomy or herniotomy wounds, coagulène prevents the formation of that "*bête noire*" of the surgeon — the subcutaneous or subfascial hæmatoma.

In bone operations the use of coagulène is especially valuable inasmuch as it checks the constant oozing of bone and surrounding tissue, thereby avoiding the necessity of repeated sponging. In a recent personal communication from Dr. Fonio (January, 1914) he states that coagulène has given the best results in bone operations, strumectomies and craniotomies. The Kocher clinic is also, at present writing, using coagulène in skin-grafting, in hæmophilia, hæmoptysis and gastroduodenal hæmorrhages. A monograph on its intravenous use is shortly to appear from the same source.

That wounds will heal more rapidly and with a minimum of connective-tissue cells between the cut surfaces, in the absence of capillary oozing, is self-evident. Fonio believes that wounds on which coagulène has been applied heal more rapidly than those not so treated. I am not, as yet, prepared to comfirm this statement which, *a priori*, seems logical. It is certain that the accurate coaptation of homogeneous tissues and the elimination of blood-clots which would tend to separate these tissues is a surgical desideratum.

In rhinological and laryngological operations coagulène is used in the form of a ten per cent spray, or sponges, soaked in the same strength solution, are applied directly to the bleeding surfaces. H. Obermüller (13) found the solution very excellent in checking secondary hæmorrhages following turbinectomies or septum resections. After the application of ten per cent coagulène he was able, with perfect safety, to send his patients home without applying nasal tampons. Used in spray form after adenectomies and tonsillectomies, it brought about efficient and prompt coagulation. Owing to the pleasant sweet taste of the solution, Obermüller used it as a post-operative gargle for children. Equally favorable results were obtained in the radical operations for antrum of Highmore disease; for ethmoiditis; in the excision of papillomata of the larynx or extirpation of the epiglottis. In all of these types of operation the field of operation is kept free from capillary oozing, and tamponade, where previously indicated, becomes unnecessary.

### PERSONAL EXPERIENCES

CASE 1. Exploratory laparotomy, September 23, 1913, Cook County Hospital. Coagulène used in abdominal incision. Capillary oozing ceased within a few seconds. Healing per primam.

CASE 2. Cholecystostomy, September 25, 1913, Cook County Hospital. Gall-bladder freed from old adhesions;

capillary oozing rapidly checked by means of coagulène. Primary union.

CASE 3. Congenital multilocular cyst of right kidney, September 25, 1913, Cook County Hospital. In this case coagulène was remarkably useful. After opening the entire kidney from pole to pole and evacuating the cysts, 10 ccm. of a 5 per cent solution of coagulène were poured in the cavity. A large coagulum formed within a minute, effectively checking all hæmorrhage. One rubber drain was left in the kidney substance for twenty-four hours. Patient made an uneventful recovery.

CASE 4. Angioma cavernosum of the right iliac fossa, September 27, 1913, Cook County Hospital. An exploratory laparotomy was performed, but, in view of the size and extent of the angioma, excision was not attempted. Coagulène was freely used throughout the operation and controlled hæmorrhage with perfect satisfaction.

CASE 5. Ravenswood Hospital, October 2, 1913. Retroversio uteri, ovarian cysts; chronic appendicitis. In this case numerous adhesions were loosened, coagulène controlling the capillary oozing with marked rapidity. Normal recovery per primam.

CASE 6. Ravenswood Hospital, October 8, 1913. Traumatic bi-inguinal herniæ. Following the experience of the Kocher clinic, I ligated the superficial epigastric arteries and veins, coagulène checking the bleeding from smaller vessels. Normal recovery; primary union.

CASE 7. Ravenswood Hospital, October 11, 1913. Encysted lipoma of right mamma. Excision; coagulène thrombus-formation, closure without drainage. Normal recovery.

CASE 8. Cook County Hospital, October 14, 1913. Nephrectomy, three weeks after exploratory nephrotomy for traumatic rupture. Hæmorrhage from adhesions was very profuse and annoying, but readily controlled by coagulène. General peritonitis was, however, already present, and patient succumbed to the infection and cachexia seven days later.

CASE 9. Angioma cavernosum of face, October 14, 1913, Cook County Hospital. This tumor, the size of an English walnut, was situated on the right cheek, opposite the external auditory meatus. It was extremely vascular and had recently become infected. Instead of applying the coagulène on the incision, I experimentally plunged the syringe needle under the base of the angioma and injected a few drops of the solution at various points in its periphery. The ease with which the tumor was excised and the almost total absence of hæmorrhage which was encountered during the succeeding steps of the operation were quite convincing of the efficacy of this method. Normal recovery.

CASE 10. Carcinoma of colon, October 16, 1913, Cook County Hospital. The ascending and transverse colon and six feet of ileum formed an inseparable mass. Adhesions were at first freed, but as the ileum was found to be the seat of metastatic growths, the entire mass was removed, the descending colon closed at the sigmoid flexure, and the normal free end of the remaining ileum implanted in the sigmoid. Throughout the steps of this tedious operation, coagulène was a valuable aid in checking hæmorrhage. The patient died of shock sixteen hours later.

CASE 11. October 23, 1913, Cook County Hospital. Fracture of olecranon process of left ulna, open repair. Coagulène applied to oozing bone and fascial surfaces. Incision closed without drainage. Normal recovery without post-operative hæmatoma.

CASE 12. October 31, 1913, Cook County Hospital. Ventral hernia. Repair by vertical imbrication. Coagulène was used throughout the operation with perfect satisfaction. Normal recovery.

CASE 13. October 31, 1913, Cook County Hospital. Double fracture of left humerus with irreducible forward displacement of distal end of lower fracture. Lane plating of lower fragments. Coagulène was freely used on the oozing bone surfaces with very marked satisfaction. Incision closed without drainage. Healing per primam. Three and a half weeks later musculospiral paralysis appeared, due to compression of the nerve in the callus of the upper fracture.

CASE 14. November 4, 1913, Cook County Hospital. Amputation of right leg. Coagulène gave ample satisfaction, checking both bone and muscle oozing. Normal recovery.

CASE 15. November 11, 1913, Cook County Hospital. Right inguinal herniotomy. Superficial epigastric artery and vein ligated; all other bleeding surfaces controlled by coagulène. Normal recovery. Healing per primam.

CASE 16. November 11, 1913, Cook County Hospital. Stricture of rectum; colored female, 39 years old. Excision through a posterior vaginal incision with anastomosis of bowel ends. Coagulène freely used to control the profuse venous hæmorrhage encountered, thereby greatly facilitating the operation. Secondary infection with retrovaginal fistula occurred. Patient was operated upon a second time by a colleague, but eventually died of sepsis.

CASE 17. January 14, 1914. Cook County Hospital. Right oblique inguinal hernia; previously "cured" by the injection of paraffin, the removal of which, with its surrounding adhesions, provoked considerable hæmorrhage. Coagulène was promptly efficacious. Normal recovery. Healing per primam.

CASE 18. January 14, 1914, Cook County Hospital. Left oblique inguinal hernia. Coagulène relied upon to check all bleeding with the exception of the superficial epigastric vessels, which were ligated. Normal recovery. Healing per primam.

CASE 19. January 14, 1914, Cook County Hospital. Retrodislocation of right clavicle. After several attempts at reduction had failed, the acromioclavicular ligaments were reached by a semilunar incision, the clavicle replaced and ligaments sutured. Coagulène freely used to check hæmorrhage. Closure without drainage. Normal recovery. Healing per primam.

CASE 20. Miss T. C., age 10. Purpura hæmorrhagica Werlhofii. Through the courtesy of Dr. R. R. Ferguson of Chicago, I was allowed the privilege of using coagulène intravenously. Dr. Ferguson's notes are as follows: On December 12, 1913, patient returned home from school feeling tired and complaining of "weakness" and pain in the epigastrium. Temperature 97°, pulse 115, respiration 18. Treated symptomatically by some other physician for one week. December 19, 1913, hæmorrhagic spots appeared about the elbows and knees. The abdominal pains continued. Patient was restless and slept poorly. Hæmorrhage from the nose, bowels, and vagina. Œdema of lower extremities; blood and albumin in the urine. Abdominal pains appeared to cease after onset of melæna. Entered Ravenswood Hospital, January 15, 1914. *Examination:* Face bloodless and slightly œdematous; radial pulse "thready." Blood issuing from nose, vagina, and rectum. Temperature 99°, pulse 130, respiration 24. Patient feels very weak and exhausted.

With the assistance of Dr. Ferguson, the left internal saphenous vein was freed at the tip of Scarpa's triangle. The patient was so exsanguinated that compression of the upper extremities did not cause any visible filling of the median basilic or median cephalic veins; hence my selection of the internal saphenous vein. A five per cent solution of coagulène was freshly prepared, sterilized and cooled to body temperature. Ten ccm. of normal saline

were first injected, then 200 ccm. of five per cent coagulène, followed by approximately fifteen ccm. normal saline solution — 250 ccm. of fluid in all. It was noted at the time that the child could actually feel the warm solution flowing up the left iliac and inferior vena cava, as she called attention to the fact!

Twenty-four hours later the hospital record was as follows: Temperature 98°, pulse 94, respiration 18. Nasal and vaginal hæmorrhages have ceased. Some bloody mucus in stools which, however, are formed and yellowish in color.

This improvement continued for three or four days, when hæmoglobinuria became marked. As I had practically exhausted my available supply of coagulène, the injection could not be repeated. A desiccated horse serum was used but no improvement was noted. At present writing (February 14, 1914) general anasarca is present and hæmoglobinuria continues. The bloody stools have ceased. The child is now evidently losing ground.

This case is cited to show that, in order to permanently check hæmorrhages due to metabolic changes, repeated doses must be given. The immediate results obtained are encouraging and warrant further clinical studies along the same lines.

Numerous blood-coagulating substances have already been offered to the profession, principally, it is true, for the treatment of hæmophilia. Wooldrige (14) was the first to show that alcoholic extracts of any kind of protoplasm had coagulating power. Bernheim (15) demonstrated the blood-coagulating power of an extract of blood-vessel walls. Von der Velden (16) discovered that 5 to 15 gms. of sodium chloride *per os* increased the coagulating power of the patient's blood. Strontium lactate, calcium chloride, and gelatine have, in the past, had their advocates. Weil (17) was the first to inject fresh horse serum in the treatment of hæmophilia, and Sahli (18) in 1910 successfully used antitoxin of diphtheria for the same purpose. The advantages of Coagulène-Kocher-Fonio over any of the preceding methods which at once suggest themselves are:

1. In powder form it is a stable solution. (The exact length of time during which it retains its maximum activity has, of course, not yet been determined. I recently used the last gramme of coagulène in my possession on a tonsillectomy and found the solution normally active after five months. It is, therefore, certainly stable enough for practical purposes.)
2. It is readily prepared.
3. It is sterilizable without losing its activity.
4. It is available for local, subcutaneous, and intravenous use.
5. On both theoretical and clinical grounds it is the most powerful coagulant at our disposal.

An unbiased critique of my twenty cases, added to the seventy-five cases reported in the Kocher clinic, convince me that in coagulène we have a preparation the employment of which tends to shorten and simplify our operative technique. Fewer ligatures are needed and capillary oozing is reduced to a minimum; therefore it would seem that primary union ought to be more readily obtained. A vast field is open, and the theoretical possibilities of this preparation loom large. Clinical reports on its use in hæmophilia, pulmonary hæmorrhage, hæmorrhagic pancreatitis, bleeding gastric or duodenal ulcers, etc., are still lacking. My single experience with the intravenous injection of coagulène in purpura hæmorrhagia was encouraging, but the insufficient quantity of the substance at my disposal prevented me from repeating the dosage. The Kocher clinic has also begun using coagulène intravenously, but reports are not yet available.

The writer feels sufficiently encouraged to pursue further investigations as soon as a fresh supply of coagulène is available and is at present confident that a useful and serviceable adjunct has been added to our surgical technique.

REFERENCES


1. Fonio. Über die neue blutstillungsmethode und Wundbehandlung durch das Coagulène-Kocher-Fonio. Cor.-Bl. f. schweiz. Ärzte, 1913, No. 13.
2. Fonio. Über ein neues verfahren der blutplättchen. Deutsche Ztschr. f. Chir., 1912, 117.
3. Bordet. L'intervention des plaquettes sanguines dans la coagulation du sang Académie royale de méd. de Belgique, 1911, June.
4. Nolf. Arch. internat. de physiol., 1905.
5. Sahli. Klinische untersuchungsmethoden, 15.
6. Lilienfeld. Zschr. f. phys., Chemie., Leipz., xx, 89.
7. Fuld. Zentralbl. f. Physiol., xvii.
8. Zak. Studien zur lehre der Blutgerinnung. München. med. Wchnschr., 1912, No. 51, 2844.
9. Bordet and Delange. Betrachtungen über die rolle der Lipoide bei der Blutgerinung. Arch. f. Exper. Path. u. Pharmakol., Leipz., 1913, v, 293.
10. Bordet et Delange. L'intervention des plaquettes sanguines dans la coagulation du sang. Ann. et Bull. de la societé royale des sciences médicales et naturelles de Bruxelles. 70, No. 8, 1912.
11. Morawitz. Deutsche archiv. f. Klin. Med., b. 79, S. 215.
12. Bürker und Kopsch. Die thrombocyten des menschlichen blutes und ihre veränderungen bei der blutgerinnung. Anat. Anzeiger, Bd. 19, No. 21, 1909.
13. H. Obermüller. Über "Coagulène-Kocher-Fonio," ein neues blutstillungsmittel und seine Anvendung in der rhinologie. München. med. Wchnschr., 1913, Dec. 23, 2832.
14. Wooldrige (1883). Proc. Roy. Soc., xviii, 181.
15. Bernheim. The relation of the blood-vessel walls to the coagulation of the blood. J. Am. M. Ass., 1910, No. 4.
16. R. V. der Velden. Deutsche Med. Wchnschr., 1909, No. 5.
17. E. Weil. Comptes rendus de l'academie des Sciences, Paris, 1905.
18. Sahli. Deutsche Arch. f. Klin. Med., 1910, 545.
19. Bürker. Blutplättchen und Blutgerinnung. Arch. f. die ges. Physiologie, 1904, cii.

# A BRIEF CONSIDERATION OF SOME RECENT TESTS FOR GASTRIC CARCINOMA

By RALPH M. CARTER, A. B., M. D., Green Bay, Wisconsin

THIS paper is simply a very brief consideration of a few of the more important tests for gastric carcinoma, and incidentally, for carcinoma in general, which I have selected from the large number of tests proposed, and with which recent literature is filled. I have nothing original to offer, and my only apology for approaching a subject on which so much has already been written is its importance, and the hope that a brief description of a few of these tests might prove of general interest.

Early diagnosis in cancer of the stomach is an absolute necessity if we are to be of any real assistance to the patient, and anything which can in the slightest degree contribute to this early diagnosis cannot be neglected. The duration of life in this condition is very short; after the disease is so far developed that the diagnosis is plain, the average duration of life is only one year. When this stage is reached, palliative treatment is alone possible.

The difficulty of this early diagnosis has led numbers of investigators, in the last few years, to seek new and improved methods by means of which the diagnosis can be made with certainty in the early stages. The solution of the question has been approached in many different ways — by some, through an investigation of the stomach-contents and urine; by others, through serological methods. The X-rays also play a significant rôle, and lately have done much to advance our knowledge of diseases of the stomach. Nevertheless, none of the many methods has realized the highest hope. Therefore, the fact remains that new investigations will always be undertaken, in order to gain a nearer approach to the difficult problem. Numerous demonstrations show, almost without exception, that none of the tests gives results which are pathognomonic for the disease in question, and their interpretation is, on that account, of not much greater value than any of the other clinical symptoms.

The test which above all others is probably the most widely known and used is the glycyltryptophan test of Neubauer and Fischer, and its modifications. As originally proposed, in 1909, the test was very simple, and could be used by any practitioner anywhere. It consisted in mixing glycyltryptophan, a polypeptid, with a portion of filtered gastric juice obtained after the usual test breakfast, incubating for twenty-four hours, and then testing with bromine vapor for the rose-violet color of free tryptophan. Their conclusions were as follows:

1. There exists in carcinomatous stomachs a ferment, which, contrary to pepsin, will split glycyltryptophan.

2. This ferment is destroyed by an acidity of .36 per cent HCl (equivalent to about 98 degrees of acidity as ordinarily determined).

3. The presence of this ferment may be of diagnostic value.

Their report was accepted with widely divergent criticism. Many investigators took up the study of the method, and obtained different results.

One of the most frequent criticisms is the fact that it was found that the gastric contents of normal individuals, as well as of non-cancerous patients, under certain conditions, was capable of splitting glycyltryptophan and other polypeptids. As an explanation of this fact, it is generally believed that the ferment causing this peptolytic cleavage belongs to the general group of ereptases, ferments capable of splitting polypeptids and peptones, but incapable of attacking native proteins. No specific action on the part of the ferment in cases of carcinoma has been observed, so far as the above cleavage is concerned; therefore, a test of this sort possesses specificity only in so far as it can be shown that the ferment present is derived solely from the carcinomatous tissue. This introduces a number of sources of error, and in order for the test to possess the slightest value, ereptases, or ferments, from the following sources must be ruled out:

1. Erepsin from regurgitated duodenal contents.

2. Ereptase from hæmorrhage into the stomach and from transudation of ereptase-containing fluids into the stomach.

3. Tissue ereptase from breaking down of cells of the gastric mucosa.

4. Ereptase in swallowed saliva.

5. In addition, protease, capable of peptolytic cleavage, as well as of proteolytic cleavage, may be present from the trypsin of regurgitated pancreatic juice, or from bacteria and leucocytes, mostly from swallowed saliva, and must be controlled.

Naturally, under these circumstances, the test becomes very difficult technically, and is not available for use by the general practitioner.

However, Friedman and Hamburger, in a recent communication, have so modified it that it holds promise of results, and more general applicability. They consider that, of all the above enumerated sources of error, the proteases of regurgitated pancreatic juice and the leucocytes and bacteria of saliva are the most active. They control these by the use of the vegetable protein edestin, which is attached only by proteid splitting ferments. They also use peptone in place of glycyltryptophan, which has been shown to be equally as good. Both peptolysis and proteolysis now come into consideration, whereas in the original test it was only peptolysis. High peptolysis with low proteolysis speaks for carcinoma; high peptolysis with high proteolysis against carcinoma. Under these circumstances, they think that the test possesses distinct value in the diagnosis of cancer of the stomach, and is of considerable service in the differential diagnosis between benign and malignant anacidity, but is of practical value only when taken in conjunction with the usual clinical and laboratory findings.

After all criticisms have been made, and sources of error ruled out, the fact remains that the gastric juice from cases of carcinoma in most cases undoubtedly shows a higher peptid splitting power than that from normal or non-malignant cases, and the routine employment of the test as originally described can do no harm, although no dependence can be placed upon it alone. But in conjunction with other clinical findings, it is a small link in the chain of evidence.

Another simple test has been suggested by Oppenheim. I have been able to find but very little on the subject in the literature at my disposal, and consequently cannot give any opinion as to its value. It consists in adding three per cent acetic acid to the filtered gastric contents, a drop at a time. If the reaction is positive, a turbidity or cloud appears which vanishes only after considerable acetic acid or a little HCl is added. Dilution with one to five volumes of distilled water does not cause the cloud to disappear. The only source of error is mucus, which also gives a cloud with acetic acid, but this cloud is unaffected by the addition of HCl and does not occur in high dilutions of the gastric contents. The filtrate must be absolutely clear. The test may be applied to vomitus, and blood and pancreatic juice are not disturbing factors. Oppenheim has made comparative tests, and finds the above reaction positive in all cases in which the glycyltryptophan test is positive. He is unable to determine upon what the reaction depends.

Still another test which has been proposed, in which stomach contents are used, is based on the presence of hemolytic substances in the gastric juice. Grafe and Roehmer first undertook this investigation, carrying on, in a way, the work of other men who had demonstrated the presence of hemolytic substances in extracts of organs and malignant tumors. The gastric juice, rendered feebly alkaline, was extracted with ether. From the residue, after evaporation of the ether, an emulsion was made with normal salt solution. This emulsion was then mixed with a suspension of washed rabbits' corpuscles. The extract from carcinomatous gastric juice dissolved the red blood-corpuscles, which action did not occur with benign diseases of the stomach, or in healthy persons. Upon further investigation, however, the test was found to be of little value for several reasons: the technique was too complicated and difficult for ordinary clinical use, the presence of trypsin in appreciable amounts also led to hemolysis, and in high-grade gastrectasis, on account of the large amount of water necessary for washing, the hemolysin was so diluted that hemolysis did not take place.

Through chemical analysis, it was determined that the hemolytic action was due to oleic acid. Grafe tried to simplify the method by determining the quantity of oleic acid by titration.

But after many trials of both methods, by many investigators, the conclusions of the majority seem to be that they possess little value, as hemolysis and high oleic acid content are found in many benign affections, and in health, and are often not found in cases of carcinoma.

These tests just described are typical and are among the most important of those which deal directly with the stomach contents, and are the ones over which most of the discussion has been. When all is said and done, they fall far short of furnishing the infallible test for gastric carcinoma which is the ultimate aim of all investigators. Of course, much work has been done toward refinements of the older methods of gastric analysis which cannot be discussed here. More stress is laid by some upon the finding of occult blood in the gastric contents and stools than seems formerly to have been the case. Zoeppritz states that the repeated finding of occult blood in the stools day after day, provided all extraneous sources of blood are ruled out, is the one sign above all others which is characteristic of beginning gastric carcinoma. In no other condition is it so constantly present.

But, in general, very little real advance has been made in gastric analysis. A large amount of information has been gathered, but it consists mostly of disconnected facts, and their general bearing on any one subject, and particularly on the one under discussion, is not yet clear.

We have now to consider the investigations which have been made concerning the general reactions and perverted metabolism of the organism in cancer.

Salkowski found that in the urine of patients suffering from carcinoma the percentage of nitrogenous matter precipitated by the metallic salts to the total nitrogen was greatly increased. While normally the so-called colloidal nitrogen amounts to about 3.5 per cent of the total nitrogen, in carcinomatous urines it was between 8 and 9 per cent. Later investigations gave the same results, which were confirmed by a few others.

Following this, many observers tested the method with varying results. It was found that a large number of diseases, in addition to carcinoma, showed an increase in colloidal nitrogen, notably chronic infectious processes, tuberculosis, heart insufficiency, and liver diseases. There were many differences of opinion regarding the percentage relationship in carcinoma. A few observers found no increase, but an actual decrease. On the other hand, many agreed perfectly with Salkowski, Caforio stating that carcinoma could be ruled out of the diagnosis if there was no increase in colloidal nitrogen.

Feuer, of Basel, from whose article I have obtained my information regarding this method, tested it in a large number of cases. He found that the reaction was absent in about one-third of the cases of undoubted carcinoma, and was present in a number of other diseases. However, this latter fact alone does not detract so much from its value if it were always present in all cases of carcinoma, because in most of the other cases the diagnosis presents no especial difficulty, with the exception of pernicious anæmia and some liver diseases, which are often difficult to differentiate from malignant disease.

He concludes that an increase in colloidal nitrogen occurs in all cachectic conditions, and that it speaks for carcinoma when all other causes of cachexia can be ruled out, such as chronic infections, tuberculosis, and heart and liver disease. A normal percentage, however, does not by any means exclude carcinoma.

Another and simpler urinary reaction, which is along the same lines as the preceding, and dependent upon the same principle, is the sulphur reaction of Solomon and Saxl. They find that the urine in carcinoma is fairly rich in incompletely oxidized sulphur, which sulphur they oxidize and determine the quantity of sulphate resulting. The general principles of the method in brief are as follows: The sulphates are removed with baryta solution, the ethereal sulphates by digesting with HCl, and the filtrate treated with hydrogen peroxide, and boiled. It is then placed in a conical glass. If positive, an abundant precipitate occurs within one-half to four hours. Normal urines do not give this precipitate in that length of time, or at most, only a trace. Any precipitate occurring after four hours is disregarded.

The literature contains many references to this test recently, the great majority of writers speaking very enthusiastically of it, although a few say that it has no value whatever. The general opinion, however, seems to be that it is positive in a large proportion of all cases of carcinoma.

Certain Italian workers, notably Ascoli and his pupils, have presented a serological reaction for cancer, based upon certain principles laid down by Ehrlich, and also upon certain laws of physical chemistry, by means of which they seem able to identify antibodies in the serum of the individual tested, when a specific antigen is employed.

In brief, the method consists of extracting the essential principles of the antigen, specific organisms, or diseased tissue being used, as the case may be, and adding this extract to the serum of the patient to be tested. The surface tension of the mixture is then ascertained. This is measured by the number of drops contained in a certain amount of the fluid, estimated by means of an instrument known as the stalagmometer of Traube.

The mixture is then allowed to incubate at body temperature, and at the end of a definite time the surface tension is again estimated. If it is increased, the number of drops in the same amount of fluid will be increased.

Ascoli claims that this increase will occur in every case in which an antigen is incubated with a serum containing an antibody, and claims a high degree of specificity for the reaction, particularly brilliant results being obtained by him in malignant disease. It occurs not only in malignant disease, however, but also in other conditions, such as typhoid, syphilis, tuberculosis, and most infective diseases.

As with the other tests, opinion as to the value of the meiostagmine reaction, as it is called, varies greatly, but a large number have confirmed

Ascoli's results, and the method, if simplified, would seem to hold promise. The technique, however, is at present much too complicated for general use.

Only a brief mention of other tests which have been proposed can be made here.

Recent developments in Abderhalden's biologic test seem to promise something, especially in determining the organ involved; the phenomena of anaphylaxis have been utilized to a slight extent as a means of diagnosis, but no definite ground has been reached; von Dungern has suggested a complement deviation reaction, which was claimed to be specific, but later researches have shown it not to be so; Sturrock finds the alkalinity of the blood increased in cancer, and on this finding alone feels justified in exploratory operation. His results have not been confirmed. The skin reaction proposed by Elsberg, Neuhof, and Geist has been found not to be specific, but a positive reaction is strong presumptive evidence of cancer.

One agent which is rapidly coming into prominence in the diagnosis of gastro-intestinal conditions is the X-ray. It is of course valuable only as an adjunct, as the diagnosis cannot be made upon the X-ray findings alone. But in the hands of experts it promises much. Serial skiagrams are necessary in order to be at all certain in any case.

In expert hands, too, the gastroscope is exceedingly useful, in many cases enabling an early and exact diagnosis, without the employment of any other means. Its employment is rapidly becoming more extended, and in the near future we may hope to see it in fairly general use, instead of being confined to a few.

The above are only a few of the many tests and methods which have been proposed in recent years. To discuss them all, would take too long. They fall naturally into three groups:

1. Those dealing with the stomach contents.
2. Those dealing with the urine.
3. Those dealing with serological reactions.

A fourth group might also be added, containing those agents other than tests directed toward the organism and its metabolism, as, for example, the X-rays and the gastroscope.

The above described are fairly typical of each group. Of these groups, the one which would seem to promise the most theoretically is the third. It is reasonable to suppose that the blood of patients suffering from malignant disease would contain a substance or substances not present in the blood of normal individuals, and the large number of able investigators who are at work on the problem would lead to hope that in the near future some specific test will be evolved.

But we must conclude that the test which fulfills the long felt want of an early specific diagnostic means for carcinoma is yet to be discovered, and that so far as the general practitioner is concerned, recent years have not helped him much, because those few tests which do supply a small degree of confirmatory evidence are too complicated and too difficult technically, except for those specially trained and with exceptional laboratory facilities.

Considering these things, it would seem that in cases of stomach disturbance presenting symptoms which lead to a suspicion of cancer, the patient should be told the exact state of our knowledge on the subject. The dangers of delay should be dwelt upon, and the individual given the opportunity to choose between uncertainty and an absolute diagnosis, which can be obtained only through an exploratory operation. The risk is small, and the information is definite. If the condition is found to be inoperable, the patient will have suffered but little additional pain and discomfort.

# TRANSACTIONS OF SOCIETIES

## CHICAGO SURGICAL SOCIETY

A REGULAR MEETING WAS HELD MARCH 6, 1914, WITH THE PRESIDENT, DR. M. L. HARRIS, IN THE CHAIR

Dr. Edward J. Lewis (by invitation) read a paper entitled "Preliminary Report of Experimental Bone Transplantation." (See p. 572.)

Dr. Edwin W. Ryerson (by invitation) read a paper entitled "The Transplantation of Bone in Pott's Disease." (See p. 578.)

Dr. E. J. Brougham and Dr. A. C. Ecke (by invitation) contributed a joint paper entitled "A Preliminary Report on the Treatment of Fractures by Fixation with Animal Bone-Plates and Bone-Screws." (See p. 637.)

Dr. H. B. Thomas (by invitation) read a paper entitled "Bone Transplant." (See p. 580.)

### DISCUSSION

All of these papers were discussed together.

DR. WILLIAM HESSERT: Bearing upon the subject of bone transplantation, I have had a patient come here to-night who represents a typical case of osteomyelitis, followed by necrosis, resection, transplantation, with a pretty fair result.

This boy first came under my observation in September, 1911. He had been sick five days with a classical history of osteomyelitis—sudden onset, excruciating pain, fever, with chills, and all the symptoms of sepsis. After five days his leg presented the typical appearance of swelling, extreme tenderness, and central fluctuation. An incision was made on the anterior aspect of the tibia; pus was found in the soft tissues and under the periosteum. At that time I opened into the medullary cavity. The suppuration subsided, the acute symptoms subsided, and the boy became immediately better, and after six weeks the lower epiphysis had become loose.

A question of practical moment is, How long shall we wait when we have complete necrosis of the shaft of the tibia before removing the necrotic tibia? Shall we wait until the tibia becomes loose, or shall we take out the necrotic bone early? I waited five weeks and the lower epiphysis having loosened up I determined on resection inasmuch as the osteomyelitic process was limited to the lower half of the bone. The entire shaft of the bone did not become necrotic, due to fairly early intervention. How much of this necrotic tibia are we to remove? In other words, how can we tell how much to remove? Does it make any difference whether we remove quite a bit of healthy bone, there being no line of demarcation? I was more or less guided by the formation of an involucrum, and from this point the periosteum was not thickened. I severed the bone at that point, and whether that is correct I should like to have some expression of opinion. That was what guided me as to the point of resection.

The subsequent history was uneventful. The wound healed up completely in about a month; there was no sinus, and I waited in this case for about a year and there was no regeneration. After six months I advised transplantation, but his family was opposed to it, and they waited for another six months, and during the greater part of that time the boy was around without a cast, and as a consequence the fibula became partially dislocated. After a year there was no regeneration. I was able to identify the periosteum in this subperiosteal resection, and thought at the time of the resection there was some regeneration, but the first picture shows there was very little. After a year a typical transplantation was made. A piece of bone eight inches long was removed from the left tibia, and three-quarters by one-half inch thick; I used the chisel and it worked nicely. With a sharp thin chisel one can chip off the desired length. This shows the site of transplantation, and has regenerated so that he again had a sharp tibial margin here.

The pictures shown illustrate the appearance of the bone subsequent to the first operation. For the next year or so there was just a little projection from below and a slight one from above. This shows the site of the removal of the graft. This shows the graft in place shortly after it was inserted and the subsequent pictures were

taken within six months after the transplantation, showing adhesion of the transplant to the tibia, the transplant having been removed in the manner indicated with a chisel, which is more or less crude as compared with the saw, but it can be done with fair accuracy with a thin, sharp chisel without the danger of spoiling the graft.

The ends of the bone were squared off. The graft was driven into the medullary cavity above and fastened below with wire. I believe that the bone-graft does not die. I have nothing but clinical evidence, but from this and my study of the literature I believe it is a fact that the bone-graft does not die. I am convinced that when a bone is transplanted a great number of the osteoblasts remain living and retain their function and that they contribute toward the growth of the bone. This graft has grown somewhat. Subsequent to the transplantation the course of the clinical history has been uneventful. I kept him in a cast for four or five months and since that time he has been walking. He went around for nearly six months with the absence of the bone there, with nothing to support it, and forced it into this position; at the same time the result is pretty fair.

I simply present it as a case of transplantation of bone following resection for osteomyelitis.

DISCUSSION

DR. ARTHUR DEAN BEVAN: We have all profited very much by this symposium on bone transplantation.

In regard to Dr. Lewis' paper, it is the clearest, most common sense presentation on bone grafting or bone transplantation I have listened to. I say that because it is entirely in keeping with my own conception of the facts. I never had any question in my mind but that exactly the same laws controlled bone grafts that control a Thiersch graft or a graft of fascia; that we simply have to look to exactly what happens in the transplant of a Thiersch graft or of a graft of fascia to determine what takes place in bone. I believe bone is simply a mesoblastic structure, peculiar to be sure, and that the peculiarity lies in the osteoblast, which has the power of reproducing mesoblastic connective tissue of that particular form called bone, and that the whole subject of the success of the graft and its condition depends upon the life of the osteoblast. If the osteoblast is placed in a condition where, as Dr. Lewis states, it can receive the proper blood supply, favorable conditions for life and growth, it will live.

The experiments he has detailed are interesting to me, and particularly those relating to cutting these bone fragments into a great number of pieces and transplanting them and demonstrating beyond any question of doubt the fact that they do live; that the osetoblasts do live and do develop into bone. This is especially shown in the case where he cut off the ends of the radius and turned the lower end of the radius into the joint. There can be practically no doubt but that the bone graft does live in that particular case.

I am very much interested in Dr. Ryerson's work, and particularly in the very practical motor saw which he has demonstrated to us this evening. It seems to me it is the most successful instrument I have seen for work of this nature.

In regard to the bone-plates, I cannot quite agree with the authors who presented this subject. The bone-plate presented seems to be an admirable device. I want to say in that connection in regard to Dr. Thomas' paper that I think he is incorrect in the statement that forty-eight per cent of the Lane bone-plates suppurate and require removal; under favorable conditions the percentage of suppurations in steel plates, properly introduced, would be very small—so small that there is hardly a fair comparison between the cases which he presents of transplanting bone into a vertebral column or any other position without any suppuration. The whole question is one of technique and of the condition of the tissues in which you make the transplant. Certainly under favorable conditions a surgeon who has ten per cent of cases that suppurate in using bone-plates would be very culpable. I cannot say offhand, but I do not believe in my own bone-plating we have had anything like five per cent of cases in which there has been any infection of any kind.

In our own work in the femur we practically never remove a steel plate. In the tibia it may seem advisable in some cases to remove the plates; where it is advisable we do so, and regard them simply as a temporary matter. They can be easily removed under a little local anæsthesia and with very little difficulty. My own impression is that where we need a plate of any kind, a steel plate in fractures would be better than a bone plate such as that presented, although I think these bone-plates should have a fair trial.

DR. CHARLES DAVISON: I have been very much interested in this work. I have watched very closely the work that has been done in the County Hospital, particularly the Albee operation, and the results seem quite wonderful. The children sent there go from bad to worse by the old treatment.

One point raised against the Albee operation is that the fixed bone-splint put in a child will not grow with the child; that it will straighten the back up too much. These cases shown to-night, growing for a long time, would not indicate that.

As to the application of the Lane plate, the Lane plate is a foreign body. It is admitted by those who have been around the County Hospital, and have seen a good deal of the surgical work done there, that many of the Lane plates that have been used have been subsequently removed, and there have been all sorts of results following the use of this plate. Three or four years ago, or shortly after the Lane plate was introduced in this country, there was a steady stream of cases coming to the County Hospital with infection from Lane plates, or rather in those cases where Lane plates had been used. Some of these patients would come in for a day and have the limbs dressed, while others would come in to have the plates taken out. Still others would come in transit to the Oak Forest Infirmary. In the use of the Lane plate, when infection takes place, the screw holes make necrotic areas which are slow to exfoliate, and new bone built up around the plate takes a long time to get well. It seems the Lane plate is passing, as so many surgeons are using other devices for the same purpose. I am in favor of the autogenous bone splint in the medulla of the long bone, taking a little chuck out of the tibia and introducing it into the medulla of the bone; this can be done much quicker than a Lane plating. It is done quickly with a saw, with very little shock to the patient, and the bone splint will slip in place easily, and we have a splint which belongs to the body, and which will be treated kindly by the body. It does not make any difference whether it stays there or becomes absorbed: it will remain there long enough for the fracture to unite. It *probably* will undergo the same process as a physiological medullary bone-plug after bone fractures. After the bones are knitted together, there will be gradual absorption and reopening of the medulla as time goes on.

The open operation for fracture of the long bones has a very brilliant future, but I think it is being overdone. It is being used on bones that should be treated by simple splints, by simple reduction and fixation by ordinary splints. Any bone that can be successfully fixed by ordinary external splints should not be subjected to an open operation which is attended with the dangers of infection. A simple fracture of a long bone can be fixed by a bone-peg taken from the tibia, with better results than with any other device by open operation.

DR. A. J. OCHSNER: The scholarly paper read by Dr. Lewis certainly has great value and it is gratifying to know that such work is being done here.

The more we have seen of the Albee operation the better we have been pleased with it. The patients as a rule have shown great improvement.

Regarding the case that Dr. Hessert has shown us, I believe that if all the tissues had been split down to the bone from a point three or four inches above the place where the incision was begun down to the lower point at which the incision stopped, and the leg had been dressed for a year and a half, the patient would now have a leg infinitely better than he has. I have not seen as many of these deformed cases following acute osteomyelitis operations in recent years as I did formerly. Some twenty years ago a case came under my care with the metatarsal bone of the great toe entirely necrotic; I made an incision and wanted to remove the bone but was not permitted to do so. That patient still carries her metatarsal bone of the great toe and there is no shortening or deformity whatsoever. I have seen the tibia necrotic for more than one-half of its length remain in place with the loss of only a small amount of tibial tissue. I have seen a number of cases like the one we have seen to-night in which new bone formed as a sequestrum by not removing the dead portion until later and invariably the result was much better than in the case just shown.

Regarding bone plating, I would like to say this: No one should plate bones unless he knows how. If bones are plated right, it is one of the best operations in properly selected cases that can be done. If you plate a bone wrong, it is one of the worst things you can do. In our bone work at the Augustana Hospital, Dr. Percy has had 108 consecutive cases in which bone plates were used, with only five unsatisfactory results. The difference between the manner of applying these plates and those I have seen that were put in elsewhere and had to be removed later is precisely the difference between a thing done right and a thing done wrong. If one watches those who do it right and those who do it wrong, it is a simple matter to see why in one case the plates have to come out and in the other cases they do not.

DR. E. J. BROUGHAM: In regard to Dr. Bevan's statement that suppuration has occurred in only five per cent of the cases in which plates have been used in his work, I would say that in

the literature we found a much larger percentage. It is that percentage we hope to do away with if the bone is absorbed. By the animal bone-plate we try to eliminate that percentage of trouble and do away with the necessity of having subsequently to take out the plates.

DR. H. B. THOMAS: My statement regarding the Lane plate was that in one series of cases studied it was found that forty-seven and seven-nineteenths per cent were removed at a subsequent operation.

DR. BEVAN: They were not Mr. Lane's series?

DR. THOMAS: It was a series of cases studied at the County Hospital. I believe that the autobone-plate will in a few years be used extensively, and probably if Dr. Ochsner has so low a percentage of suppuration as four per cent in his cases, with the Lane plate, he might have none by the use of the autobone-plate.

DR. BEVAN: That would not represent the average work?

DR. CHARLES DAVISON: I think the surgical work done at the County Hospital would fairly represent the work done throughout the country. Of course, Mr. Lane is an expert in putting in these plates, but I have known cases in which Lane plates had to be removed a long time after Lane himself had put them in.

DR. OCHSNER: While in England a great many surgeons were asked if they had taken out any Lane plates that were put in by Mr. Lane himself, and there was not one of them who had taken out a single Lane plate.

DR. THOMAS: I do not intend to convey that my report represents the average per cent of Lane plates removed: it represents the results in the records reported on. It is known that some patients died before the plates could be taken out. Regarding the County Hospital, those on the staff who do work there are men who have secured their positions by civil service examinations and are considered well qualified.

DR. BEVAN: I would not like to leave the impression that I am criticizing the surgical work done at the County Hospital. Not at all, but I do not think the statement that it is necessary to remove Lane plates in forty-seven per cent of the cases on account of suppuration is a fair statement of anything like the possibilities of the Lane plate, because we do not know all the other facts in the case. Possibly many of the Lane plates referred to may have been put in in compound fractures. It is well known that Lane himself never puts a plate in a compound fracture. The percentage mentioned does not represent the possibilities of clean aseptic work with Lane plates, and I think Dr. Ochsner's statement is quite correct, that where the work is well done without any preceding suppuration, three or four per cent would represent nearer the facts than forty-seven per cent.

DR. CHARLES DAVISON: I think an error in the percentage comes from a misunderstanding of the facts. A great many cases come into the County Hospital with the plates already in, and these probably are included in the statistics. In many of them the wounds are suppurating and the patients are in bad shape.

DR. THOMAS: To repeat, my point is simply this: I had a trained nurse under my supervision, a woman of intelligence and considerable education, look over 450 histories in Cook County Hospital; from these, which were the fracture cases for several years, those in which the Lane plate had been used were studied and the percentage I have mentioned determined. I grant you, that had the records of many hospitals been considered, this percentage would be too large. It occurs to me after what has been said and from the results that I have given you, the autobone-plate will after a while take the place of the metal plate, because it is not foreign material, and in a large number of cases in which bone-splints have been used they have remained and have done the work.

I believe that more cases are plated than should be. In those that should be plated use the autobone-plate when possible and you will get better results with less careful technique.

# CHICAGO GYNECOLOGICAL SOCIETY

A SPECIAL MEETING OF THE SOCIETY WAS HELD DURING THE WEEK OF THE CLINICAL CONGRESS OF SURGEONS OF NORTH AMERICA, NOVEMBER 15, 1913, WITH THE PRESIDENT, DR. FRANK W. LYNCH, IN THE CHAIR

DR. L. S. MCMURTRY, of Louisville, Kentucky, read a paper entitled "Hysteromyomectomy: Its Evolution and Perfection." (See p. 556.)

Geheimrath Professor Dr. Krönig, of Freiburg, Germany, followed with a paper by invitation entitled "The Difference between Former and the Newer Treatments by X-ray and Radium in Gynecological Diseases." (See p. 529.)

DISCUSSION

DR. CHARLES E. PADDOCK: We are to be congratulated on having with us to-night as our guest such a distinguished professor in medicine, and I am sure we have all profited by the scientific address to which we have just listened. Especially was I interested in the statistics given in the use of scopolamine and morphine in labor. The report is so at variance with my own limited experience that I am at a loss to understand it.

A few years ago the medical literature contained many reports from individual practice and large clinics upon the use of scopolamine and morphine in obstetrical practice, and while many of these were as favorable as those of the essayist, as many more were decidedly unfavorable.

At this time I gave it a fair trial and the result was so disastrous that I nearly discontinued the use of these drugs in confinement, and now use them only for those very few selected cases where I believe them to be indicated, such indication arising in only about one-tenth of all obstetrical cases in labor.

My objections to the use of these drugs are, first, that we do not always get the result expected, the drug acting differently at times; second, it retards labor and frequently results in the termination of the labor by the use of forceps; third, the injurious effect upon the baby, as in many cases the baby is born in profound asphyxia; fourth, the danger of post-partum hæmorrhage.

I will merely cite one case which illustrates my experience in several. The patient, a primipara, was given 1/150 gr. of scopolamine, and 1/6 gr. of morphine in the early stage of labor. In a short time the pulse went to below fifty, the respirations to ten per minute, and the face was alternately flushed and cyanotic, the patient delirious most of the time. This continued, as I remember it, for many hours, with a final cessation of labor pains and a final resort to the use of forceps. The baby was born in asphyxia, and could not be resuscitated. This was in a private family and to this day I am called the murderer of that child.

The above report is probably an exaggeration of the others where I have met with failure in the use of the drug.

The principal fault I have to find in the use of these drugs is the effect upon the baby, and I am surprised that the essayist has not had such an experience. Nearly all of the babies in my experience are born in asphyxia, and many of them are with great difficulty aroused and occasionally they are born dead.

DR. RACHELLE S. YARROS: I am exceedingly interested in the subject that has been brought before us. In this country we have not given sufficient attention to it. We find a great many of our women are easily exhausted in labor, and we have to use instruments quite frequently. I do not know, but perhaps the American women, of the upper classes, are different from the German women who belong to the upper classes; but I have felt that we have not given sufficient attention to the use of scopolamine and morphine in obstetrics.

I have used these drugs in a number of cases, and have had an experience similar to that related by Dr. Paddock in two cases. First of all, we use scopolamine-morphine in the same doses we do in surgery, namely, 1/100 of a grain of scopolamine, and 1/4 of a grain of morphine. We use it at intervals of an hour, mainly in the middle of the first stage of labor. The women are made comfortable, but labor is prolonged in multiparæ. In primiparæ we were not able to determine the value of the method. The internes complained bitterly that they never knew when the case would come off, and that was one great objection. The reason why we gave it up was this: First of all, we had three badly asphyxiated cases. The fourth one we lost. We could not resuscitate it. We decided on the use of oxygen as soon as the baby was born.

In private practice, where we do not have oxygen, I would be afraid to use these drugs.

I should be very grateful to Professor Krönig if he would tell us the exact time when he begins to use these drugs and the dosage. It is very essential that we should find some method by which we can diminish the pain of labor, because I believe that the modern women cannot stand as much pain as the women of the past.

Dr. Robert L. Dickinson, Brooklyn, New York: As one who has used scopolamine-morphine and then abandoned the method because of the difficulty of resuscitating children; as one who has visited Professor Krönig's clinic, and again taking it up under better instruction, I desire to speak on this subject, although the new series of cases is not yet sufficient to determine whether our babies are in greater danger. We have oxygen always at hand. A distinction between the old method and the new has perhaps not been made by Professor Krönig, but as I understood it at Freiburg, there is an attempt made to have a definite interval of four or five or six hours between the last dose of morphine and the delivery of the child. Of course, no man can tell just exactly what that interval is, but certainly in our experience, giving morphine in the early part of labor, as was taught in Freiburg last year by Professor Krönig, has made a difference in the number of asphyxias.

Dr. Gustav Kolischer: I think that Dr. Yarros struck a keynote when she said that the American woman of the higher class cannot be judged by the physical standard of the average women who are furnishing the material for the German clinics. But the untoward results of the scopolamine anæsthesia that Dr. Yarros is reporting may be sufficiently explained by other factors also, the same factors that brought this anæsthesia somewhat in disrepute with most of the obstetricians here in Chicago. We saw collapses in the mothers and certainly an increase in the mortality of the babies. There are two instances that may be held responsible for that. Firstly, the scopolamine that was at our disposal was a rather uncertain drug: the preparations on the market were of different strengths and were also unstable; they decomposed rather rapidly and some of the undesirable results were undoubtedly due to this changed quality of the drug. We were given to understand, however, that Professor Krönig's chemist furnishes a preparation that is equally reliable in the whole output and is also absolutely stable. Secondly, there is an essential difference between Krönig's dosage and the doses we were used to administer. We, and so did Dr. Yarros, always injected one milligram scopolamine per single dose while as I understand it Krönig administers less than one-half of one milligram as a single dose. Neither scopolamine nor morphine is known to have an accumulative effect, so that the toxic effect of the first dose may have worn off before the next dose is given. If we give at intervals the same amount in two or three doses that we used to give in one dose, this point is sufficient to explain the difference between Krönig's and our results.

As to the radiotherapy of myomata of the uterus, a criticism of this method depends entirely upon the standpoint one is taking as to the remote results of operative interference in sarcoma of the myomatous uterus, and as to the primary mortality of myomectomy. If one believes that we are able to obtain definite cures by operating on myomata that have degenerated into sarcoma, then one may object to the indiscriminate radiotherapy of the myomata of the uterus. At the same time we have to admit the possibility that a sarcoma contained in a myomatous uterus may have been cured and may again be cured in the future by the influence of the X-rays or by mesothorium rays, or, as we were recently told, by the action of a hundred thousand dollars' worth of radium.

As to the primary mortality of myomectomy I would like to call attention to the fact that conclusions based on statistics must always be taken with a grain of salt. While Krönig figures the total primary mortality to vary between four and five per cent, it still is a fact that some operators can look back on long series of operations without a single death. Dr. Frankenthal who is operating at the Michael Reese Hospital reported some time ago an unbroken series of 125 myomectomies without a single death. Of course the objection may be raised that such an absolutely favorable series may be followed by a number of bad results; but still, facts are more convincing than mere theorizing.

There is one feature, however, that may help us out of these difficulties: modern laboratory work has developed a way of diagnosing malignancy that could not have been diagnosed by any other clinical evidence, and that is the serum diagnosis of malignant tumors. If the promises held out by the laboratory men will come true, then all these dilemmas will be solved. In case the serum test points to malignancy, the believer in the operative cure of uterine sarcomata will resort to the knife and will shun the radiotherapy; if, on the other hand, the radiotherapeutist will have succeeded in making disappear a uterine

tumor under similar conditions, then his claim that malignant tumors of the uterus may be cured by hard rays without the risk of an operation will be definitely established, and if that is done a great step forward will be assured and for this enrichment of our therapeutic armament we will be indebted to the Freiburg clinic.

PROFESSOR KRÖNIG (closing the discussion): With reference to the remarks of Dr. Yarros, I will say that while the American ladies are more beautiful than the German ones, I do not think they show less resistance. I think the German and American women are about equal in that respect, because I have had the good fortune of having delivered quite a number of American women under scopolamine-morphine narcosis without mortality incident.

Dr. Kolischer has stated that in former years the scopolamine was not a constant entity; that it was liable to decompose rapidly and in decomposing it not only became inefficient but developed new and dangerous properties that endangered the lives of the children. In our first thousand cases we almost lost three women from the effects of decomposed scopolamine, but since our chemist has been able to furnish us with a stable, reliable drug of equal strength, in three thousand cases we have not lost one mother. The mortality in children did not increase above the general mortality in the first year. Therefore, if Dr. Paddock's results differed so widely from ours, it is fair to assume that his technique must have differed somewhat from ours, or that he had the misfortune of using an unstable or decomposed drug.

As to radiotherapy in the treatment of myomata of the uterus, I would like to say that according to the statistics collected by us, the percentage of sarcoma in uterine fibromyomata is not more than one per cent. In fact, of those cases of myomata that were treated with X-rays, we did not lose one case by sarcomatosis. Statistics show that of all cases that were operated radically for sarcoma of the uterus, 33 per cent were dead inside of three years, all of the patients having died from recurrence of the disease.

PROFESSOR DOCTOR GAUSS, Freiburg, Germany, read a paper entitled "Report of the Result of Radiotherapy in Gynecology."

DISCUSSION

DR. LEWIS S. MCMURTRY, Louisville: My contribution to this symposium was an effort to present the development of the surgical treatment of uterine fibromyomata preparatory to the paper of Professor Krönig, to the delivery of which we have just listened, in order that we might have a thorough presentation of the present status of the subject, and then be able to apply the suggestions that have been so ably and germanely presented. This is not the first time, Mr. President, that an effort has been made to replace surgical methods by non-surgical methods in the treatment of uterine fibromyomata. Those present will remember the efforts of Professor Apostoli in this direction with electricity and of Dr. Keith after his great surgical triumph in this field, who abandoned surgery and adopted electrical treatment.

The difference in the suggestions made by Professor Krönig as to the non-surgical treatment is very marked. Professor Apostoli at the time he advocated this treatment had never successfully treated these cases by surgery, while the other had abandoned surgery; but here in advocating the treatment of these tumors by the röntgen rays we have a masterful surgeon, who has had experience in surgery, and who presents these facts to us. Those of us who have visited Professor Krönig in Freiburg, and have witnessed his work, can all realize that when he speaks on this subject we are listening to a master surgeon, consequently when he makes suggestions as to supplanting established surgical methods with another method, it commends itself to our careful consideration. It is certainly a very remarkable presentation of facts, and I am sure that we are all very greatly indebted to him for presenting this very scientific paper. Before this treatment can be properly tried, it requires one to master the technique as has been done by Professor Krönig, and to conduct the treatment with the greatest care, precision, and with scientific accuracy.

I have no doubt, as a result of Professor Krönig's visit to this country, this treatment will be thoroughly tested here, and I trust with the most satisfactory results.

DR. ROBERT L. DICKINSON, of Brooklyn, New York, followed with a paper entitled "Efficiency Engineering Applied to Gynecological Surgery," which was illustrated by numerous stereopticon slides. (See p. 559.)

DISCUSSION

DR. RICHARD R. SMITH, Grand Rapids, Michigan: This is a very timely paper, full of thought and suggestion by a man of large experience. Dr. Dickinson is, above all things, a practical man, and he has that far-seeing imagination which makes for progress. I think we have all been pleased with the progress gynecology has made

in the past years in lowering the mortality rate, bettering all our final results, as has been pointed out by Dr. McMurty to-night; but we are not satisfied and should not be, for there is still a great deal of room for improvement, not only in reducing the mortality and improving our results, but in making the ordeal of operation and the time in hospitals a less trying one. If we are to do this we must make still further progress; we must study more carefully our hospital efficiency not only in the operating room, but in every other department of the hospital. If we will remember efficiency in any line of business, as has been brought to our attention so much of late, if we compare hospital efficiency with the high standards attained in business, we will not be satisfied.

There are many things in hospitals that one might speak of, but I wish to speak of one thing particularly; and that is, service in our hospitals is in line with what Dr. Dickinson has had to say with regard to standardization. We have been prodigal of the time and efforts of those who are working in our hospitals, more particularly our nurses, and little thought has been given to the cutting down—to simplifying the work of our nurses. The giving of a few enemata, a few douches, always running back and forth from the drug-room, the sleeping room, etc., really consumes a forenoon for the average nurse, and a little thought directed to this would simplify the matter. I mention this to show that there is a tremendous waste of time and energy. If we could give it the thought required, we would not only improve our hospital work, but our patients would be better off, it would give our nurses more time for study and recreation, and we would be able to lead a far more rational life. So much for the nurse's work in the hospital.

When we come to the operating room we find the same waste of time on the part of the nurses and assistants. One man recently in one of the largest clinics in this country watched the work of the utility nurse for a forenoon,—the nurse who does the work about the room,—and he counted the steps she took during the forenoon in going back and forth. Besides the manual labor she accomplished, she walked four miles. It does not seem as though that is necessary; and surely it cannot be; it should be and will be cut down.

When we come to study the work done by the assistants—how many assistants are really necessary to do efficient work, to do thoroughly rapid work, and thoroughly good work? If we are to arrive at a conclusion, we must study the work that has been done in various clinics. Dr. Dickinson has pointed out the necessity of introducing these things in clinics. Jones, in Liverpool, England, operated upon twenty orthopedic cases in a forenoon, with but two assistants. Everything was simple. Everything went off rapidly and the work was beautifully done. On the other hand, in one of the most brilliant clinics here we saw a large number of assistants, with a great deal of confusion, so that literally they were falling over each other. These things must be and can be standardized. We must get down to something more simple. One thing that is necessary to bear in mind is the fact that work in a hospital is largely done by the women, and necessarily this must be so. Every surgeon knows what is needed to take hold of these problems and to improve them, and I only call attention to these things because I feel very strongly the necessity of studying this subject both in the operating room and as a practitioner.

Dr. John A. Hornsby was asked to take part in the discussion. He said: We hospital administrators think of two or three things in connection with hospital progress to-day. First, while it is not a part of our business to tell you how to do your work, we have our own opinion about it, and one of the things we think is not quite as modern as it might be is the getting of patients back to bed in good enough shape. We administrators think you ask us to take care of your desperate cases when they get back to bed. That means one of two things: you have taken too long to do the operation, or that we have not done our part in the operative technique that has permitted you to do your work fast enough. We are not going to inquire at this stage of the game which it is.

Another thing we find is this, that surgery varies. Some surgery is done with two and one-half per cent carbolic acid spray, and from this we come all the way down to the fancy needle work of Dr. Dickinson. We find this to be true: You have grown in your surgical operative technique from one nurse and possible one interne (the interne being a luxury), clear down to the point now where the gynecologist is commandeering three nurses and three internes, and some sort of an anæsthetist. There are six people and the operator. We find from our standpoint that we are in each other's way,—I mean the internes and the nurses,—and yet you are calling for more, more, all the time. That is due to one or two things—and we are going on the assumption it is our fault, the administrative side of the work. Probably you have been going so fast and doing

such splendid surgery in these last few years that you have not stopped to think about our part of it, and the result of it is that in nearly every operating room I go into to-day there is the command of the surgeon to "hurry, hurry, get this quick, get that quick." We do not believe that the work is done in such a workmanlike manner from our standpoint that the best results to you are being obtained. I have seen in some parts of this country, and know of places abroad, where an operator will have but one assistant, one woman assistant or a man assistant, and he seems to go through his operation without any friction, without any trouble. He operates quickly, he gets through, and gets his patient back to bed, and nobody is worried at all. When we see that, we wonder whether it is not a mistake to call for more people, more tables, more wash basins, more instruments, and the infinitude of apparatus and detail so that you cannot move about in the operating room at all. Now, I am not going to say whose fault it is. I do not know. That is not my business. But some of us a few years ago undertook to begin to ask that question. We have got to this point now and I am going to tell you very briefly what we have done. We have a hospital section in the American Medical Association. We had been working for some years in the American Hospital Association, but we were not reaching the right people—the doctors—who eventually must direct the affairs in hospitals if they are to be conducted along scientific lines, and you may as well begin that direction now. You have not done it up to this time. As I have said, we have a hospital section in the American Medical Association, and we have a similar section in the American Hospital Association, which also has a committee. At the meeting of the Clinical Congress of Surgeons of North America a committee was appointed to coöperate with the other two committees, of which Dr. Codman of Boston was chairman. I am chairman of one committee, and Dr. Hurd, of Baltimore, is the other chairman. Now, we are going in all directions to see if we cannot get some inspection of hospitals with a view of establishing standards by which the hospitals themselves may further their efficiency. One of these propositions was that the hospital people should undertake to inspect and standardize the hospitals themselves. That seems obviously impossible to be done. You cannot standardize yourselves. Then it was proposed that the American Medical Association should begin standardization and do this work. And again it came up, but the doctors are really the people who are at fault and they cannot standardize themselves very well. Then the proposition came up that inasmuch as the Carnegie Foundation had done such a brilliant piece of work in connection with medical education, it should undertake this work. That proposal is still in the air. Then again, the proposition came up to ask the United States Public Health Service to make an inspection of a certain class of hospitals with a view to establishing these standards. Just what we are going to do it is impossible to say. We are going to do something. The hospitals are going to have some help.

I receive letters every day asking what is the ethics of this, what is the standard of that, and what is the technique of the other? I do not know, because in the hospital with which I was connected for some years, I found that one surgeon wanted one thing done in one way, and he needs five nurses and three internes; another surgeon wants it in another way, although he has less assistance and more apparatus; so that there is no head nor tail to it, and we are trying to get something out of the chaotic condition in our hospitals of to-day. This does not confine itself at all to the surgical department. It goes into every part of the hospital administration, organization, equipment, and architecture. I bespeak for this problem of ours the earnest support of the whole profession everywhere. We have not had much of your support or interest in this matter in times past. We have not had your presence at any meeting of our sections or at our association. We cannot get anything from you but complaints. We have tried earnestly and faithfully to get you to attend the meetings of the hospital association, but you do not do it. You only stay at home and quarrel with what is being done. It occurred to us that if we invited you to attend the hospital section of the American Medical Association, we could talk over our troubles and correct them, but you do not attend this section as you ought to do. You stay away. The hospital section at Minneapolis was composed of about fifty people, this year. I will venture to say that not nine members in actual practice attended our section, and yet you are asking us for a tremendous lot of work and more and more every year. We know you need it; we want to give it to you, but we must have some sort of order.

# BOOK REVIEWS

## A CRITIQUE OF NEW BOOKS IN SURGERY

By M. G. SEELIG, M. D.

AS a rule, and for self evident reasons, third or later editions of any medical volume claim scant attention from the reviewer. An exception must be made of the fourth edition of Cripps' work, in order to note certain standard types of excellencies which cannot be emphasized too often. The volume[1] itself and its general make-up are so well and deservedly known as a classic that detailed comment is superfluous. There are nineteen chapters in all, the last four devoted to cancer of the rectum, and the first fifteen to anatomy, methods of examination, malformations, hæmorrhoids, prolapse, abscess, fistula, ulcer, fissure, stricture, pruritus, impaction, polypus, villous tumors, and sacral tumors.

The tone of the book, one is almost tempted to say the very feel of the book, lends assurance that here is a special subject treated by a man that commands the fields of general surgery and pathology. The volume is what it is, because it furnishes adequate information based both on fundamental principles and extensive personal experience, and clothed in pure and simple English, a recipe that will inevitably produce a good book. But Cripps has added two other ingredients: he has selectively described views and methods other than his own, thus making a good book a full book, and he has skillfully furnished just enough of the leaven of human interest and humor to make the full book a readable book. His illustration of the inconvenience caused by prolapsed hæmorrhoids in the case of the barrister who was so frequently the subject of this accident when he rose to address a jury, his warning against using harsh paper to cleanse the anus after stool, with the added caution that the printer's ink used on radical newspapers is particularly irritating, and his vivid description of an impacted jam pot in the rectum make the book one to be read rather than merely to be consulted.

The chapters on Cancer of the Rectum are admirable in so far as the clinical descriptive side is concerned, but totally inadequate from the point of view of modern operative technique; the transsacral and the abdominal route operations are dismissed with a few words and the description of his own operation smacks of surgical days long past.

[1] On Diseases of the Rectum and Anus, Including the Sixth Edition of the Jacksonian Essay on Cancer. By Harrison Cripps, F. R. C. S. Fourth Edition, New York, The Macmillan Company, 1914.

PROFESSOR BRYAN[2] has written a handy, presentable, fairly well illustrated volume of some six hundred odd pages, on the Principles of Surgery. He has, with almost meticulous care, adhered to the formal manner of treating the subject, under the various heads: Asepsis, Wound Healing, Inflammation, Gangrene, Ulcer, Sinus, Fistula, Burns, Tumors, etc., etc. The sum total of the effort is a fairly readable and accurate presentation of a well classified mass of surgical data. As far as the essential facts are concerned, none of them are open to question; in many instances, however, additional facts might have been furnished by way of confirming old, or establishing new principles. For example, under gangrene, mention might have have been made of the recent excellent studies of thrombo-angeitis obliterans; the work of Meltzer on magnesium sulphate as a motor depressant should have been incorporated under the head of tetanus; in the chapter on rabies, a few words should have been added to make clear the distinction between street virus and fixed virus; the principles underlying shock should have been stated more fully; in discussing burns, some mention should have been made of the vast amount of investigative work done on the effects of the absorption of altered proteids; and under the head of anæsthesia mention at least should have been made of the intratracheal method.

All this, however, constitutes suggestion rather than criticism. The constructive critic must see, and therefore must needs point out, the all-important fact that Professor Bryan has entitled his volume "Principles" and yet has so far failed either to state specific principles, or to emphasize their importance, as to rob the volume of the character connoted by the title. For example, if we contrast the chapter by Bryan on bacteria with the recent Harvey lecture by Vaughan,[3] we note that Bryan in forty-five closely packed pages fails to state what Vaughan says, in a paragraph, regarding the essential principles governing bacterial action and tissue reaction. Why confuse the student with the false notion that an accurate classification of bacteria constitutes the enunciation of a surgical principle? Under the head of asepsis and antisepsis there

[2] Principles of Surgery. By W. A. Bryan, A. M., M. D. Philadelphia & London: W. B. Saunders Company, 1913.

[3] J. Am. M. Ass., 1914, Feb. 21.

is not even a hint at the all-important principle that an antiseptic sufficiently potent to destroy vegetable (bacterial) cells is equally powerful in destroying cells of the human body; furthermore, the principle of osmosis as a factor governing the penetration and hence the effectiveness of germicides is not mentioned; if we may credit very excellent experimental work done abroad and careful work done in America, 95 per cent alcohol is a far better antiseptic than 70 per cent or 50 per cent alcohol, because the stronger the percentage, the more active is the osmotic power, and yet Bryan restates the old dogma of 50 per cent efficiency.

Under the head of inflammation we may very properly consider, from the practical as well as the philosophical point of view, that the most important principle lies in the fact that inflammation is a constructive and conservative rather than a destructive force. Bryan elides this fact. The important principle underlying shock is that all the vital body functions are compromised. This is a broad generalization that finds no emphasis at Bryan's hand. A most important practical principle in hæmorrhage is the fact that the white blood count goes up, even before the red blood count goes down. Bryan does not state this, even by way of differentiating shock from hæmorrhage. Verworn, Meyer, and Overton have supplied us with an excellent basis in explanation of the action of anæsthetics, but none of their conclusions are incorporated as principles by our author.

No good would come from pointing out in greater detail the author's failure to emphasize fundamental principles. Indeed, our purpose is not to practice sharp critique, but rather to drive home the fact, pointed out by de Nancrede fifteen years ago, in his "Lectures upon the Principles of Surgery," that many of the excellent works on the principles of surgery are marred, as regards their usefulness, by the attempt to render them too comprehensive. Bryan's volume mirrors industry, care, and thoughtful design. It misses out rather by overreaching than by failure to hit the mark. The book is admittedly intended chiefly for students; it purposes to teach students surgical principles and yet it not only fails to define what a surgical principle is, but also repeatedly confuses the student by encompassing the various principles in masses of data properly belonging to works dealing with the fundamental (laboratory) branches of medical science.

EVERY now and then there appears a book[1] that stirs the selfish heart of the reader to wish himself the sole possessor of the volume, a sensation closely akin to the spirit of the antiquarian who loves his book in a measure proportioned to its scarcity value. One experiences such a sensation on reading the new operative surgery by Krause and Heyman, which has just appeared. The bold, large, wide margined pages, with their beautifully clear type and marvel ously executed illustrations make a lasting appeal on first inspection.

The plan of the work is pretentious. There are to be six volumes in all, of which only the first two have appeared, dealing with the general principles of operative technique and the surgery of the head. The fundamental purpose back of the work is to detail operative procedure both from the purely technical as well as from the clinical point of view. In this we note a similarity to the excellent English work on operative surgery by Jacobson, and a variation from almost all other similar treaties. And just here we may say that these first two volumes furnish excellent testimony that Krause is going to turn out a finished product in every sense of the word.

Volume I takes up in great detail the subjects of preparation for operation, anæsthesia, aspesis, bandaging and after-treatment, the treatment of head injuries, operations for tumors of the face, plastic operations on the face, surgery of the eye, ear, nose, and sinuses, and finally the surgery of trifacial neuralgia. If we say that each of these various subjects is handled in a fashion that mirrors mastery, we shall spare ourselves the impossible task of specific criticism in necessarily limited space. It is a pity that Krause omitted intratracheal insufflation, under the head of anæsthesia, and it is difficult to explain the omission, for only recently, in current literature, he commented on the excellence of the procedure, in head surgery. The chapter on trigeminal neuralgia is a particularly interesting one, in that it furnishes a complete description of all types of operations on the gasserian ganglion and all its branches, and also in that Krause states unequivocally that many cases of trigeminal neuralgia are permanently cured by alcohol injections.

The second volume, consisting of three hundred and fifty pages, takes up the surgery of the superior and inferior maxilla, and the mouth, resection of the temporo-maxillary articulation, surgery of the pharynx, salivary glands, facial, occipital and cervical nerves, and finally, the surgery of the brain. This final part, devoted to the brain, follows very closely the lines developed by Krause in his two volume work on the brain and spinal cord, and is an essential to every one who aspires to know and do neurological surgery.

The most exacting critic who set about deliberately to discover flaws in either of the two volumes would find himself confronting a problem. In the second volume no mention is made of the admirable method of approach to the temporo-maxillary articulation devised by Lilienthal, but even this omission may be overlooked on the basis that Krause is presenting data from the point of view of his own personal experience.

Finally, a critique of these two volumes must call special attention to the illustrations. Even we, in this country, who have grown more or less accus-

[1] LEHRBUCH DER CHIRURGISCHEN OPERATIONEN AN DER HAND; KLINISCHER BEOBACHTUNGEN. Von Prof. Dr. Fedor Krause in Gemeinschaft mit Dr. Emil Heyman. Berlin and Wien: Urban and Schwarzenberg, 1913. Parts I and II.

tomed to the high standard of surgical illustrating set by Broedel with his beautiful ross-board and wash work, must marvel at the accomplishments of Krause's anonymous artist. The plain black and white, as well as the colored plates, are artistic gems; but what is more important, they tell the story of the steps and details of the various operations so clearly that the text often becomes a matter of secondary consideration.

A good book, as well done as this, is an inspiration.

THE wish selfishly expressed above, to own the volumes of Krause to the exclusion of all other readers, might have been attended with a lurking sense of faint shame were it not for the fact that there was to follow the expression of the hope that an equally attractive book, by Kanavel,[1] might be placed in the hands and under the eyes of every medical practitioner. If one were asked to name the classical medical treaties on the hand, he would be safe in venturing as an answer. the monograph in Volkmann's Vortraege by Gerhard—Die Hand des Kranken—and this volume by Kanavel.

Kanavel himself notes the inexplicable fact that although the importance of the subject of acute infections of the hand has been recognized since earliest times, the student cannot find clear descriptions of the various types of disease, with methods of diagnosis and treatment, in either textbooks or special articles. This want is now adequately filled. In his work, of which this is the second edition, Kanavel describes under two heads the simpler hand infections, and the grave infections, under which latter head he takes up tenosynovitis, fascial space abscess, lymphangitis, and allied conditions. His method of developing his thesis is admirable; a general discussion of the important points in diagnosis, followed by the general principles underlying treatment, then four chapters on the anatomy of the hand and forearm as it bears on the surgical treatment of these regions, and finally seventeen chapters devoted to a detailed consideration of the pathology, symptomatology, diagnosis, differential diagnosis, and surgical treatment of the various grave types of infection.

Any man who has enjoyed the privilege of extensive out-patient work, and who has practiced carefully the arts of observation and inductive reasoning, will have confirmed, independently, many of the practical conclusions reached by Kanavel. Those who have not enjoyed such privilege will find that in treating acute diseases of the hand, this book will serve as a *vade mecum* to be trusted under all conditions as a safe, sane, and invaluable guide.

[1] INFECTIONS OF THE HAND. A Guide to Surgical Treatment of Acute and Chronic Suppurative Processes in the Fingers, Hand, and Forearm. By Allen B. Kanavel, M. D. Second Edition, Lea & Febiger. Philadelphia and New York, 1914.

THE excellent reasons why every physician should know medical history[2] are so numerous that they might well be codified; and yet it would seem that the doctors as a class are waiting for some gentle Elia to savor the subject and serve it in the form of *Tales of Old Physic.* However this may all be, we feel that there is a distinct place in a specialized journal of surgery, among reviews of surgical books, for a note on a purely historical work; and if justification is necessary, we plead a pardonable degree of Chauvinism, in that Garrison's History of Medicine is the product of an American. Furthermore, is is not only the most adequate history of medicine ever turned out in our country, but also compares most favorably with any other one volume work produced anywhere, not even excepting Julius Pagel's *Geschichte der Medicin.*

As regards simplicity and beauty of style and diction, adequacy of illustrations, and attractive and orderly development of sequence, nothing is left to be desired. Adhering to the now well-established formula of treating the history of medicine in eras, Garrison discusses, in twelve chapters, the subjects of Primitive Medicine, Egyptian Medicine, Sumerian and Oriental Medicine, Greek Medicine, The Byzantine Period, The Mohammedan and Jewish Periods, The Mediævel Period, The Renaissance, and the Seventeenth, Eighteenth, Nineteenth, and Twentieth Centuries, in order. By the discriminating use of heavy faced type and small print, Garrison furnishes balance to his pages, and, as it were, a foothold to his reader. Furthermore, his admirable interpolations regarding the cultural aspects of the various periods lends a certain charm of personal warmth that is most attractive. For instance, under the head of the cultural aspects of medicine during the 1700 period, he brings us in close face to face contact with many notables, among them, Hunter, Haller, Heberden, and Garth; their doings, their clothes, their earnings; he pictures eighteenth century quackery in a fashion that should, through a sense of historical perspective, assuage us in our wailings concerning present day charlatanry, and bring us peace; and then finally he outlines the status of surgery in the various continental countries, the growth of hospitals abroad and of hospitals and medical schools in America during this era.

The introduction is ostensibly a preface of purpose, but as a matter of fact, it is a charmingly discursive essay on the history of medicine, in which, among other things, a gentle quietus is put upon the doctrine of the enthusiast who advocates lumbering up the already burdened curriculum of the medical school with an obligatory course on the history of medicine.

[2] AN INTRODUCTION TO THE HISTORY OF MEDICINE, WITH MEDICAL CHRONOLOGY, BIBLIOGRAPHIC DATA, AND TEST QUESTIONS. By Fielding H. Garrison, A. B., M. D. Illustrated. Philadelphia and London: W. B. Saunders Co., 1914.

SURGERY, GYNECOLOGY AND OBSTETRICS

AN INTERNATIONAL MAGAZINE, PUBLISHED MONTHLY

VOLUME XVIII JUNE, 1914 NUMBER 6

# THE DIAGNOSIS AND SURGICAL TECHNIQUE TO BE EMPLOYED IN THE HANDLING OF ACUTE ABDOMINAL CONDITIONS, ILLUSTRATING MANY INTERESTING POINTS IN DIAGNOSIS AND TECHNIQUE WITH ORIGINAL DRAWINGS[1]

BY JOHN YOUNG BROWN, M. D., SAINT LOUIS, MISSOURI

I WOULD indeed be lacking in gratitude if I failed to express to the fellows of the Southern Surgical and Gynecological Association my deep appreciation of the great honor conferred upon me in electing me to the highest office within your gift. Until quite recently it was my intention to follow the usual custom on such occasions, and to deliver to you a general address, but after reading and re-reading the masterful oration of my distinguished predecessor, Dr. J. M. T. Finney, delivered at the last meeting of this association, and hearing his equally scholarly address at the recent meeting of the American College of Surgeons in Chicago, it seems to me that the subject matter usually covered in such addresses has been exhausted — at least for a time.

I, therefore, trust that you will pardon me if I depart from the usual rule and present to you a subject of my own selection; namely, the diagnosis and surgical technique to be employed in the handling of acute abdominal conditions, illustrating many interesting points in diagnosis and technique with original drawings. Under this head, I shall consider —

First. Gunshot and stab wounds of the abdomen.

Second. Injuries to abdominal viscera, resulting from severe abdominal contusions.

Third. Acute intestinal obstruction.

I have selected the above-mentioned subjects for the reason that they constitute a distinct group of acute abdominal conditions where immediate operative treatment is mandatory, the mortality depending upon the time of operation and the technique employed.

With the exception of the last subject, acute intestinal obstruction, few individual operators have had the opportunity to draw conclusions from a large series of cases to be treated under the first two headings, namely, gunshot and stab wounds of the abdomen, and severe abdominal contusions. I, therefore, will present in detail certain points in the diagnosis and technique of this work which I have found of value in the handling of a large number of such injuries. I shall then take up some important technical methods which I have found of value in dealing with the equally serious pathology resulting from acute intestinal obstruction.

[1]President's Address read before the Southern Surgical and Gynecological Association, December 17, 1913, Atlanta, Georgia.

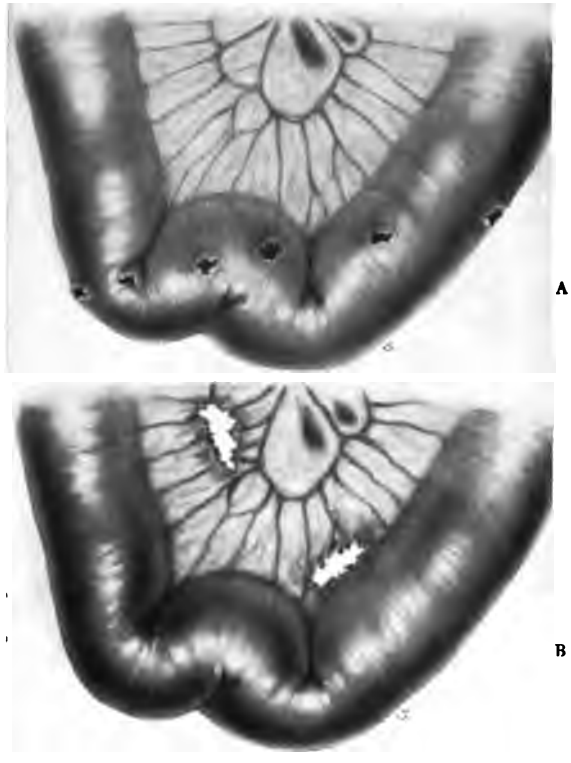


Fig. 1. A, Multiple gunshot wounds of the small bowel. Patient suffering a fatal injury with no immediate symptoms indicating the seriousness of the injury. B, Multiple gunshot wounds of mesentery. Patient suffering fatal injury with immediate symptoms of hæmorrhage and shock.

### GUNSHOT AND STAB WOUNDS OF THE ABDOMEN

*Classification.* Gunshot and stab wounds of the abdomen may be classified under three heads:

1. The simple penetrating wound, or a wound where the knife or bullet penetrates the peritoneal cavity without injury to abdominal viscera.

2. Penetrating and perforating wounds, or wounds where the knife or bullet penetrates the peritoneal cavity and injures either solid or hollow viscera, or both.

3. Complicated wounds, or wounds in which the entrance to the abdominal cavity is made by knife or bullet through chest, pleura, and diaphragm with or without injury to abdominal viscera.

*Diagnosis.* It is at times exceedingly difficult to differentiate between the simple penetrating wound and the penetrating and perforating wound. I have time and again operated on a patient whose abdomen has been penetrated by a bullet with both a wound at entrance and exit, where no damage to peritoneal viscera was found when the abdomen was opened and careful search for perforations was made. Such wounds give few or no symptoms. Again, I have operated on many cases in which there were present no symptoms indicating the serious nature of the injury for the reason that the patient was not bleeding, as the perforations were in the "bloodless" portion of the bowel.

Fig. 1 illustrates the difficulties encountered in differentiating between the two types of wounds. The simple perforating wound is the type of wound that the military surgeon often reports as recovering from undoubted multiple bowel injuries, without operation. The civil surgeon recognizes that there is no method of telling whether injury to hollow viscera has occurred, unless perforations are demonstrated by means of an abdominal section and careful search. I, therefore, seriously question the diagnosis in the reported recoveries from such injuries under the expectant plan of treatment.

In the penetrating and perforating wounds giving no alarming symptoms, delay in exploring is the usual rule, and when the exploration is at last made the patient is found to be suffering from a lethal peritonitis. In contra-distinction to the symptoms occurring in the above-mentioned cases, we have another type of penetrating and perforating wound, giving immediate and alarming symptoms. In these cases multiple perforations of the mesentery are present and profuse bleeding occurs at once, bringing about profound symptoms of shock. Such cases demand immediate operative treatment.

In the penetrating and perforating wounds with multiple injuries to liver, spleen, hollow viscera and mesenteric vessels, the diagnosis, of course, is simple.

Complicated wounds resulting from both knife or bullet are wounds in which the peritoneal cavity is penetrated by the entrance of the bullet or knife through the chest, the abdomen being opened through the dia-

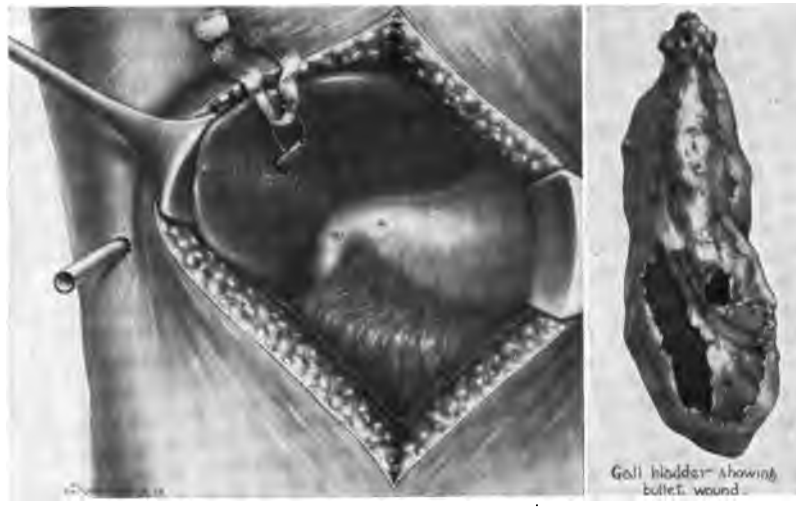



Fig. 2.

phragm. While the majority of wounds of this type are readily recognized, I have seen quite a number of such injuries in which the diagnosis was difficult. In all stab and gunshot wounds, where the bullet or knife enters as low as the sixth interspace, irrespective of symptoms, injury to the diaphragm should be suspected and such wounds should be explored. The exploration should be made preferably through the abdomen. Should exploration be made through the chest and an injury to the diaphragm be found, it would be impossible to tell, without opening the abdomen, whether or not fatal perforations of hollow viscera existed, unless there is present severe shock indicating hæmorrhage. The abdominal route is, therefore, the method of choice, as it will enable the operator to view the damage and apply at once proper methods of repair to both abdominal viscera and diaphragm. This is the only certain method of making a correct diagnosis in cases of this character.

Before taking up the technique to be employed in the handling of these cases, I shall call your attention to several illustrations of the various types of wounds coming under the classification above outlined. Fig. 2 illustrates a type of penetrating and perforating wound. It will be noted that the bullet entered the peritoneal cavity at the lower border of the ribs on the right side, penetrating liver, gall-bladder, and stomach, the wound of exit being at the outer border of the left rectus muscle. This patient was operated on one hour after he was shot and his recovery was uneventful.

Fig. 3 shows a complicated stab wound of the chest and abdomen in which may be seen the spleen, small intestine, omentum, stomach and colon, prolapsed through the diaphragm into the pleura. There were multiple visceral injuries in this case, but the patient recovered following a combined operation.

*Treatment.* There is but one treatment of such injuries and that can only be accomplished by means of immediate abdominal section and careful repair of all damage to viscera.

The surgical treatment of gunshot and stab wounds of the abdomen may be considered under four heads:

1. Preparation and examination of patient.
2. Method of locating injuries to peritoneal viscera.
3. Repair of such injuries.
4. After-treatment.

*Preparation and examination of patient.* As many of these cases are received profoundly intoxicated, it is advisable, unless the patient has vomited blood, to wash out the stomach before the anæsthetic is given; the

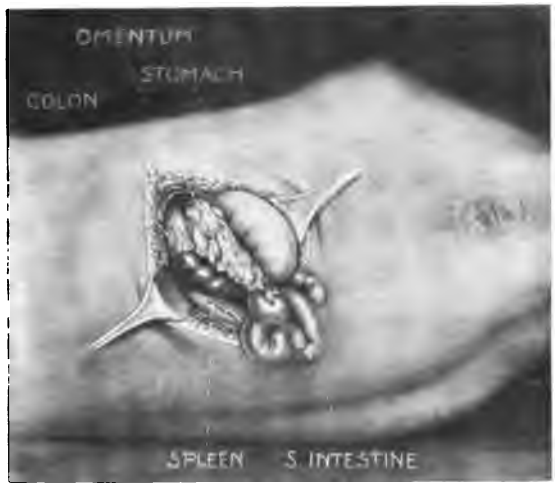



Fig. 3.

removal of the stomach contents will greatly aid both anæsthetist and operator. The abdomen should be prepared in the usual way and the wound of entrance should be carefully explored. No information whatever can be obtained by the use of the probe.

Fig. 4 shows the proper method of incising the wound of entrance and tracing the wound into the peritoneal cavity with the sterile finger. On the left-hand side of this illustration may be seen a classical stab wound of the

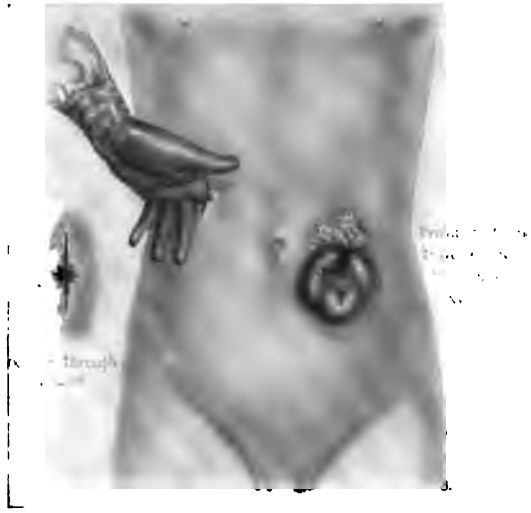


Fig. 4.

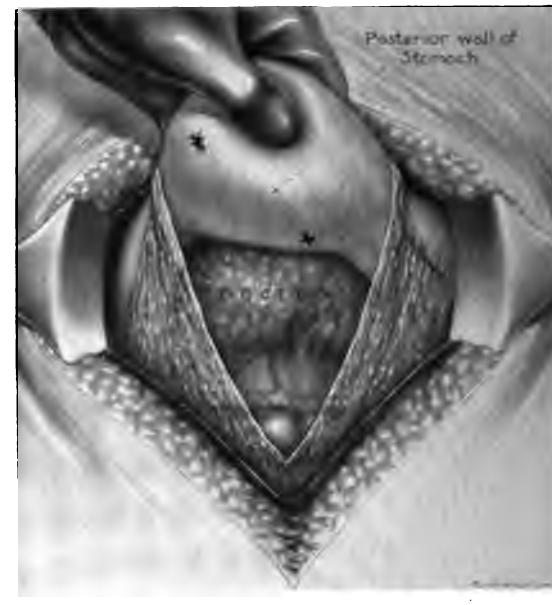



Fig. 5.

abdomen showing the prolapsed small bowel and the omentum protruding from the wound. Before returning prolapsed bowel and omentum, it should be carefully cleansed with normal saline. Occasionally you will find a loop of strangulated bowel in the stab wound. The strangulation is readily relieved by enlarging the wound.

The patient having been prepared, the abdomen is opened through a median incision, beginning an inch below the ensiform cartilage and extending an inch below the umbilicus. This incision gives free access to the abdominal viscera and can be lengthened in either direction if conditions demand.

*Method of locating injury.* There is nothing of more importance in dealing with injuries of this type than a thorough examination of the entire peritoneal contents. It is a well-known fact that unless a systematic search for visceral injuries is made, perforations will be overlooked and the overlooked perforation is, as a rule, the one responsible for the patient's death. It is, therefore, necessary that such a search be made in a manner that will enable the operator to handle the viscera as gently and rapidly as possible, without adding to the already existing shock. The

Fig. 6.

Fig. 7.

method I have found most satisfactory is as follows:

As soon as the abdomen is opened the liver and spleen are examined, and if hæmorrhage from either organ exists it should be properly dealt with. If such hæmorrhage can not be controlled through the median incision, it is advisable to cut the rectus at right angles. This procedure, while by no means ideal, will enable the operator to quickly control the hæmorrhage, and produces less shock than would follow the forcible retraction of the median incision and the rough handling of the injured viscera. The anterior border of the stomach is now searched for perforations. If no perforations are found, a rent is made in the gastrocolic omentum, opening into the lesser peritoneal cavity. Through this opening the posterior wall of the stomach is examined and any injury to the stomach or pancreas is noted.

Fig. 5 shows the technique. The wound in the omentum is at once closed in the manner shown in Fig. 6. The transverse colon is next examined and particular attention is paid to both the splenic and hepatic flexures, as wounds in this locality are frequently overlooked. Throwing back the transverse colon, the small bowel will be seen to emerge through the transverse mesocolon as is shown in Fig. 7. Lifting up the small bowel at the angle of Tritz, the operator examines it inch by inch as the assistant returns it to the peritoneal cavity (Fig. 8). All perforations found are immediately repaired, and when the small bowel is traced to the ileocæcal valve, the operator may feel confident that no perforations have been overlooked. The cæcum, ascending and descending colon, and sigmoid are next examined and if, in the judgment of the operator, it is necessary, the patient is placed in the Trendelenburg posture, so that any wounds that may exist in rectum or bladder may be located and repaired. I have found this method of search simple and satisfactory. If the patient is profoundly shocked, it is generally my custom to start irrigating the abdominal cavity with saline, as soon as the peritoneum is incised. Fig. 9 will illustrate the method by which this is accomplished. You will note the stab wound above the pubis with the drain placed in the vesicorectal pouch and the saline flowing from the tube. This irrigation is not done for cleansing, but for stimulation. It is astonishing how quickly a badly shocked patient will show signs of improvement as the hot saline is absorbed. I called attention to the value of this procedure in a paper read

Fig. 8.

before the Mississippi Valley Medical Association on Oct. 12, 1904. Dr. E. Wyllys Andrews, of Chicago, has since devised a special irrigating apparatus for this purpose.

In the repair of perforations of the bowel I have found that they can best be closed either by a purse-string suture or by a through and through stitch, supplemented by the Lembert stitch. Not infrequently multiple perforations are found in close proximity, necessitating bowel resection. Fig. 10 illustrates a rapid method of bowel resection in such cases. The bowel is folded on itself and the mesentery is clamped with a strong forceps, the segment of injured bowel is rapidly removed, and a cobblers' stitch is now placed to control hæmorrhage. The anastomosis can then be made with the Murphy button or suture (Fig. 11).

It is far better to resect in such cases than to repair with suture if there is the slightest question regarding the blood supply to the bowel.

### WOUNDS OF THE LIVER

Gunshot wounds of the liver are seen far more frequently than stab wounds. This is explained by the fact that the majority of people are right-handed, hence, with two individuals facing, the knife in the right hand, would naturally strike the left side. Hæmorrhage from liver wounds at times is profuse, but as the blood pressure in the liver is the lowest in the body, such wounds have a tendency to cease bleeding without interference, unless a large vessel is injured. I again wish to call attention to Fig. 2 which illustrates a method used to control hæmorrhage due to a gunshot wound of the liver in which the gall-bladder and stomach were also injured. You will note the catheter introduced through the wound of entrance and through the wound in the liver, after the gall-bladder has been removed. You will also see the strip of gauze threaded through the loop in the catheter, ready to be drawn through the liver, and the wound of entrance. This accomplishes the double purpose of hæmostasis and drainage.

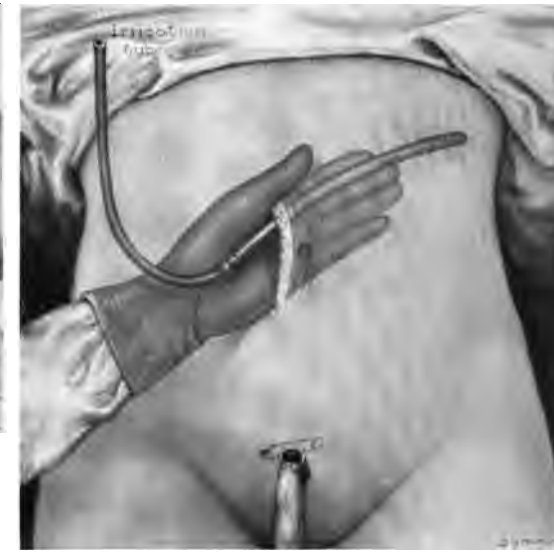


Fig. 9.

Fig. 12 shows a method of controlling hæmorrhage from the liver by the use of gauze and suture in combination.

Fig. 13 shows a method of controlling wounds of the liver by the suture alone. In this connection let me say that no special needle is necessary for this work. If a large needle is threaded with No. 3 catgut and we sew with the eye of the needle, instead of the point, we get the same results that would be gotten by the use of the many special needles that have been devised for this work.

### GUNSHOT AND STAB WOUNDS OF THE SPLEEN

Gunshot and stab wounds of the spleen are quite common, particularly the latter. It is

Fig. 10.

Fig. 11.

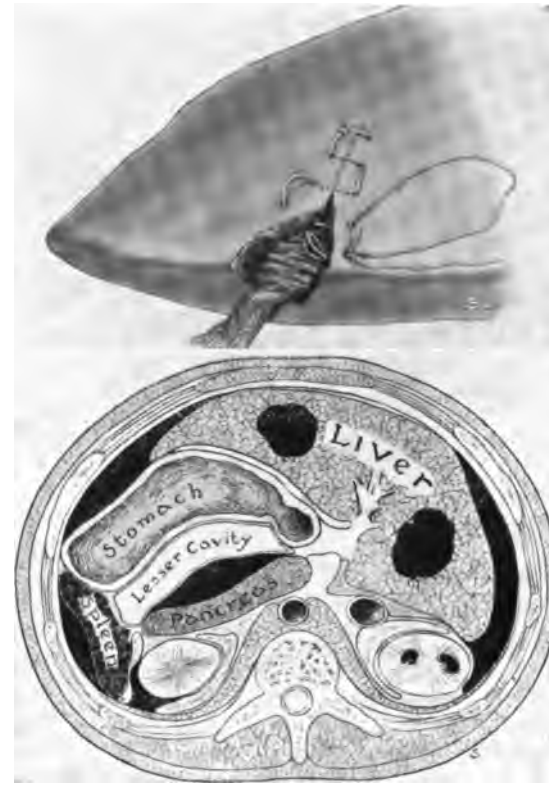



Fig. 12.

important, if possible, to save the spleen. This can often be done by sutures and gauze. Fig. 14 illustrates a method of reënforcing the sutures by utilizing the omentum. To my former associate, Dr. Kirchner, belongs the credit for devising this technique which has been the means of saving the spleen in a number of cases without the use of which splenectomy would have been necessary. If the rent or wound in the spleen is such that it can not be repaired by suture and omental reënforcement, the spleen should be removed. Fig. 15 shows the spleen delivered through the abdominal incision, ready for removal. Fig. 16 shows the interlocking figure of eight sutures in place, to control hæmorrhage from the stump after removal of the spleen.

### INJURIES TO THE DIAPHRAGM

The handling of complicated wounds is at times difficult, as the diaphragm is invariably injured. Prolapse of viscera into the chest is the rule, and we have to deal, not only with the pleura and diaphragm, but with the abdominal contents as well. If a loop of bowel is prolapsed into the pleural cavity and the bowel is perforated, the pleura is always infected. A wound of the diaphragm can frequently be repaired through the chest wound, and when the wound in the chest is sufficiently large to permit such repair, it should be done (Fig. 16). As the abdomen must be opened in all such wounds, the combined method is the method of choice. Fig. 17 illustrates the diaphragm being repaired through the abdominal incision. Note the forceps pulling the diaphragm down.

It is astonishing how slightly the patient is affected by a pneumothorax of one side. I have often viewed, through a huge chest wound, the lung partially functionating with the patient lying tranquilly on the table. After the diaphragm has been repaired, in-

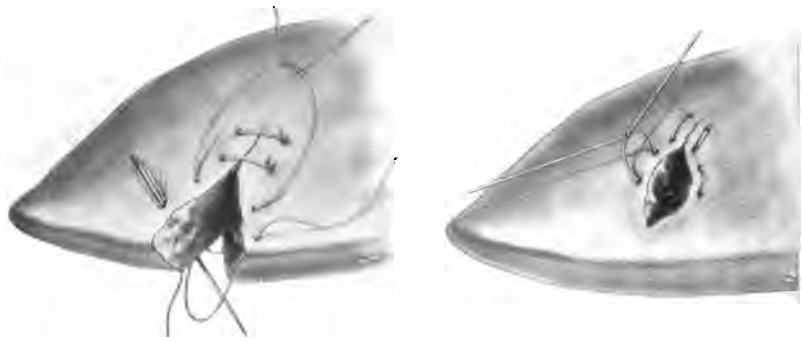


Fig. 13.

juries to abdominal viscera should be searched for and properly handled. If there has been no contamination of the pleural cavity, the chest wound should be closed without drainage. If, however, infection of the pleura is suspected, drainage should be instituted.

It has been my invariable custom to drain all gunshot and stab cases where there was extensive soiling of the peritoneal cavity and where severe hæmorrhage existed. The drainage is accomplished by means of a glass tube introduced through a stab wound above the pubis and placed at the most dependent portion of the vesicorectal pouch, as illustrated by Fig. 19. In the lower left-hand corner is shown the improper method of placing the drain, the cut above showing the proper method.

*Closing the abdominal wound.* If the patient is badly shocked, the wound should be closed with a through and through suture, as it can be more quickly applied than the layer suture. Although it would seem out of place to illustrate the technique of a through and through closure before so distinguished a body of surgeons, my observation has been that few operators make such a closure correctly. Fig. 20 illustrates the method taught by that great pioneer and master abdominal surgeon, the late Joseph Price. The closure is made with a long, straight needle; the skin is retracted and the needle is made to pierce the margin of the skin and body of the rectus muscle, catching the edge of the peritoneum. The needle next traverses the opposite side in the same manner. When the sutures are all placed, the ends are bunched and the wound is elevated by traction. When the sutures are tied, it will be seen that the peritoneum will approximate, and perfect coaptation of like tissues from below upward is accomplished. A beautiful coaptation of skin is obtained by using the "gliding approximation" taught us by the lamented Price. If the patient is not too badly shocked, the ordinary closure should be made.

### MORTALITY

The mortality in gunshot and stab wounds of the abdomen is high—approximately 50 per cent. Dr. Kirchner and I are now at work carefully tabulating the large number of cases coming under our care during our service at the St. Louis City Hospital. We hope to publish shortly a complete analysis of the histories of all our cases. Granting a mortality of 50 per cent following operative treatment of such injuries, I candidly believe that 100 per cent mortality would result from the expectant plan of treatment in all cases where multiple bowel perforations existed.

As the after-treatment of gunshot and stab wounds is practically the same as that applied to the treatment of the conditions which are next to be considered, I will discuss it later.

### INJURIES TO ABDOMINAL VISCERA RESULTING FROM SEVERE ABDOMINAL CONTUSIONS

Such injuries are, as a rule, the result of falls, kicks, or blows to the abdominal wall,

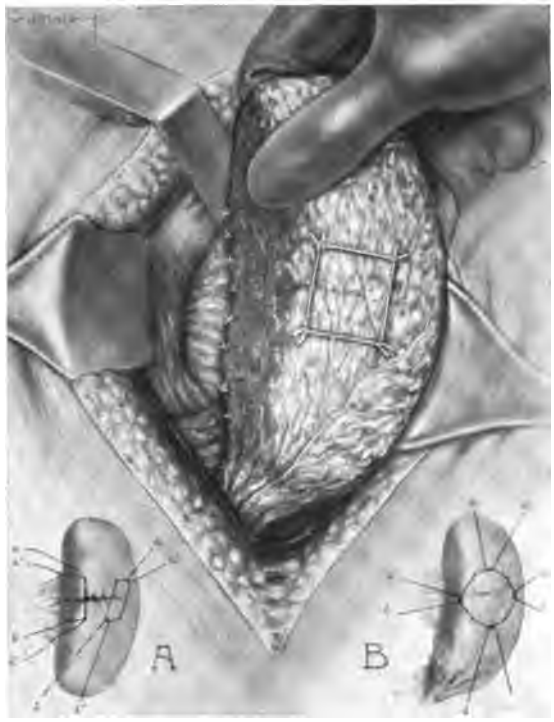



Fig. 14.

Fig. 15.

automobile accidents, etc. The viscera usually involved are the liver, spleen, small bowel, mesentery, and bladder. In many of these cases, profound symptoms of shock immediately develop. In others, the symptoms are slight. Careful examination of such patients will, as a rule, indicate that injury to viscera has occurred. Early exploration should be the rule in all such injuries. To show that severe damage to viscera can exist without producing alarming symptoms, I shall briefly relate a case:

A young boy, seventeen years old, who came under my care at the St. Louis City Hospital. While returning from swimming, he fell heavily upon a large boulder, striking his left side. Although he suffered temporarily from shock, he was able to walk to his home, a distance of eight blocks, one-half an hour after receiving the injury. Three days after the accident he was admitted to the hospital with a high temperature, rapid pulse, and on examination a large mass was found on the left side in the region of the spleen, extending well over to the midline. The expectant plan of treatment was applied in this case. Twenty-four hours after admission the capsule of the spleen ruptured, and although splenectomy was immediately done, he died a few hours later, as the result of hæmorrhage and shock due to a large rent in the spleen.

Another most interesting case illustrated by Fig. 21 was admitted to the hospital with the following history: This patient, a telegraph operator by occupation, while intoxicated, was struck by an automobile and rendered unconscious. Regaining consciousness, he came to the hospital and was admitted as a "walker." Upon examination it was found that he had sustained a fracture of the upper third of the right arm, abrasions and contusions on the legs and hips. At this time there was no evidence of the existence of internal injuries. When admitted to the hospital at 3:50 A. M., his pulse was 100, respirations 24, temperatue 98.8°. On the following afternoon, his pulse was 84, respirations 24, and temperature, 101°. He complained of abdominal pain and was unable to urinate. The abdomen became distended and tympanitic. The recti muscles became rigid and there was dullness in both flanks. He complained of intestinal cramps and vomited fluid containing undigested food. His pulse was 118, respirations 24, and temperature 100° Fahrenheit. A diagnosis of obstruction was made and the abdomen was immediately opened. The mesentery was found bruised in several places, and in one place there was a large rent extending from the root of the mesentery to the border of the intestine. A loop of small bowel was found prolapsed through the mesenteric rent

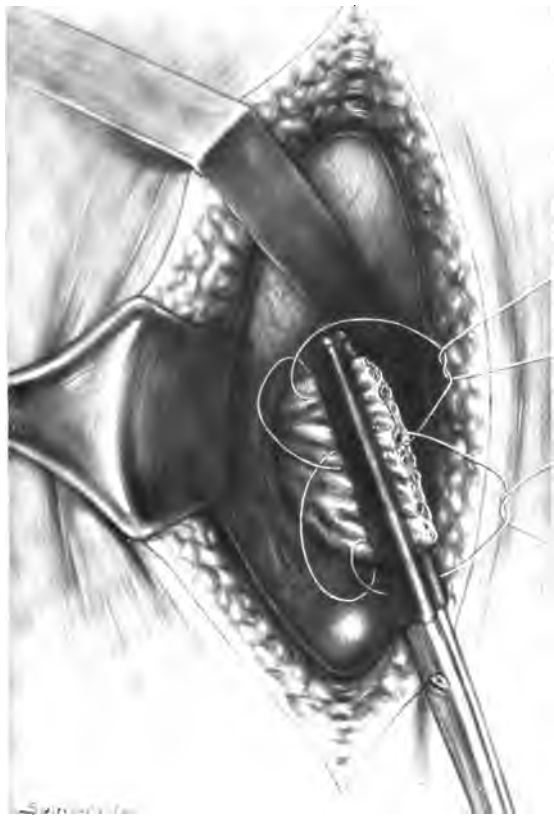


Fig. 16.

and tightly constricted. The obstruction was reduced and the mesentery was repaired. No further injuries were found. The patient made a rapid recovery.

The two cases reported above illustrate the fact that severe and fatal injuries of this type may exist with practically no symptoms. In contra-distinction to the symptoms found in the two cases above reported, Fig. 22 shows a severe injury to mesentery and jejunum.

This patient, a well nourished male, 29 years old, was admitted to the hospital twenty minutes after having been run over by a wagon. He gave evidence of profuse hæmorrhage and was badly shocked. The abdomen was immediately opened and the injury to the jejunum and mesentery as here shown was found. The mesentery was repaired, resection of the bowel was made, and an end-to-end anastomosis was done with the Murphy button. The patient died, twelve hours after operation, of shock.

### RUPTURE OF THE URINARY BLADDER

Rupture of the urinary bladder almost invariably results from abdominal contusions. Such ruptures may be extra or intraperitoneal. Uncomplicated injuries to the bladder of this type are readily recognized and respond quickly to early operation. The complicated types, namely, those in which there exists severe injury to pelvic bones and to abdominal viscera, give a high rate of mortality. Ten

Fig. 17.

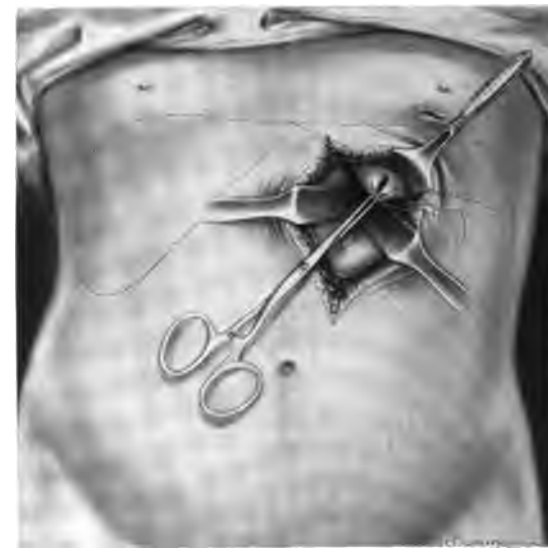


Fig. 18.

cases of rupture of the bladder have come under my observation. Three of these were extraperitoneal. All recovered following operation. Four were intraperitoneal ruptures with two recoveries. I may add here that one of these cases was operated on by me in 1888. Of the complicated cases, namely, those where intraperitoneal rupture of bladder exists, associated with severe crushing of pelvic bones, all died.

Fig. 19.

### ACUTE INTESTINAL OBSTRUCTION

At the last meeting of this Association, Dr. Alexius McGlannan of Baltimore presented a splendid clinical study of 181 cases of acute intestinal obstruction. In this paper he clearly demonstrated the importance of the early recognition of this condition and its prompt relief by surgical measures. In a recent paper read before the American Association of Obstetricians and Gynecologists, Dr. Walter C. G. Kirchner reported a careful study of seventy cases of bowel obstruction occurring during his service and the service of the writer at the St. Louis City Hospital. From a study of these cases, he arrived at practically the same conclusions as those of Dr. McGlannan. Both the studies of Kirchner and McGlannan show a high rate of mortality and that a large majority of such cases reach the operating table late. In the seventy cases reported by Kirchner, forty-seven were due to strangulated hernia. Of the forty-seven it was necessary to resect

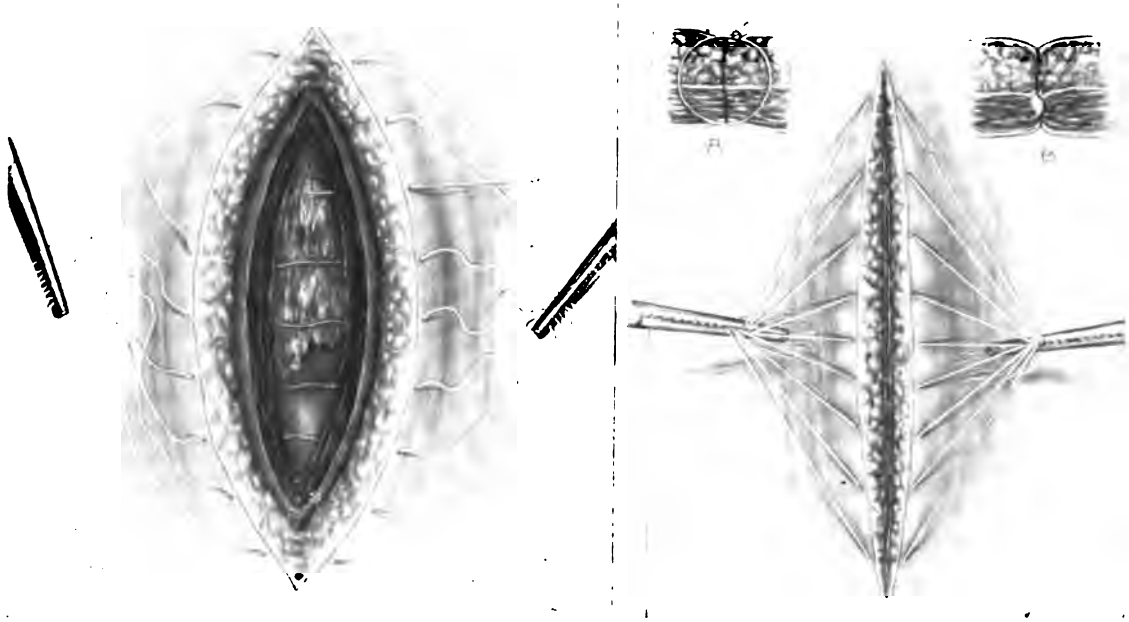


Fig. 20.

Fig. 21.

gangrenous bowel in fifteen, and in two enterostomy was done. The mortality was 28.8 per cent. Of the various obstructions not due to hernia there were twenty-three: one in which resection was necessary, and in three enterostomy was performed. Mortality was 52 per cent. In ten cases of obstruction due to post-operative adhesions bowel resection was necessary in one, and in one enterostomy was done. The mortality was 50 per cent. Four cases of obstructions due to pre-operative adhesions, in one of which enterostomy was done, resulted in a mortality of 50 per cent.

From the frightful mortality resulting from this condition we can reach but one conclusion, namely, that the general practitioner is badly in need of enlightenment on this subject. In our series of cases some rather unusual conditions were found. Fig. 20 illustrates the condition found in a case which I briefly report.

The patient, 55 years old, was admitted to the hospital profoundly shocked and vomiting fæcal matter. The abdomen was greatly distended. His pulse was 96, his temperature was subnormal. He was immediately taken to the operating room, and on opening the abdomen a huge gall-stone was found blocking the ileum, eighteen inches above the lieocæcal valve. One of the interesting features of this case was that the patient had a Meckel's

Fig. 22.

diverticulum. This, however, had nothing to do with the obstruction. The gall-stone and diverticulum were both removed. The patient made an uninterrupted recovery.

Fig. 24 illustrates a most interesting case, that of a young man who came to the hospital with the history of eight days' illness. The boy was the son of a doctor, and his father stated that from early infancy he had suffered at frequent intervals from intestinal colic and vomiting, usually relieved by castor oil. On admission to the hospital, his condition was critical. On opening the abdomen, his appendix was found attached to a Meckel's diverticulum, and through the opening made by this attachment the small bowel had prolapsed, twisting the pedicle of the Meckel's and bringing about an acute obstruction. The diverticulum was gangrenous. The appendix and diverticulum were quickly removed, thus relieving the strangulation, and the boy made a nice recovery. Fig. 25 shows the gangrenous diverticulum and appendix.

*Treatment.* No hard and fast rules can be laid down relative to the treatment of acute obstruction. Too much stress can not be laid on the importance of preparing such cases for operation. As the majority of them come in profoundly toxic and vomiting fæcal matter, stomach lavage should invariably be

Fig. 23.

Fig. 24. Showing appendix attached to Meckel's diverticulum, small bowel imprisoned under loop, twisting pedicle of diverticulum, which was found to be gangrenous at operation.

done before the anæsthetic is given. The surgical technique should be carried out as rapidly as possible, consistent with thorough work. I can not too strongly emphasize the importance of draining the bowel of its highly toxic contents in every case.

Fig. 26 shows a rapid method of accomplishing this drainage in cases requiring resection. You will note the tube in the proximal bowel. While the assistant is draining the distended gut above the constriction, the operator is tying off the mesentery. It will be seen that by this method no time is lost and when the resection has been accomplished and the distal end made ready for anastomosis, the distended loop above has been drained of a large quantity of material which, if left, would greatly interfere with the patient's

Fig. 25.

Fig. 26. Method of draining distended loop above block.

recovery. I reported this method in a paper read before the Mississippi Valley Medical Association, in 1904.

In handling gangrenous bowel found in the sac of a strangulated hernia, I have found the method which I will now describe of great value in making an artificial anus. Fig. 27 shows the sac opened and the loop of gangrenous bowel delivered. The constriction having been relieved, a wide resection well back into healthy bowel is done in the following manner: A heavy clamp is made to perforate the mesentery on either side at its intestinal margin and is then closed tightly, thus controlling the hæmorrhage. Two clamps are then placed in order to prevent the healthy bowel from receding into the peritoneal cavity and two other clamps are placed to prevent leakage from the bowel to be removed. When these clamps are placed, the gangrenous gut is quickly cut away. Fig. 28 shows the two ends of bowel fixed in the hernial opening, the clamp on the mesentery filling the double purpose of controlling the mesenteric hæmorrhage and holding the two ends of bowel in position. In the left-hand corner of Fig. 28 will be seen a rubber tube into which one-half of a Murphy button has been inserted. A tube of this type is

Fig. 27.

then introduced into the lumen of both bowels and retained there by means of a purse-string suture.

Occasionally we find a knuckle of small bowel tightly constricted and gangrenous in the sac of a femoral hernia. In all such cases, where it would be unsafe to return the bowel to the peritoneal cavity, and resection has to be done, it has been my practice to make a supplementary abdominal incision, relieving the constriction, pulling the bowel through the abdominal wound, and resecting in the manner described above (Fig. 29). This method makes resection very much safer than by operating at the hernial site. When resection is done at the hernial ring there is always danger of interfering with the approximation, whether made with the button or suture, returning the bowel to the peritoneal cavity.

*After-treatment.* The after-treatment of all

Fig. 28.

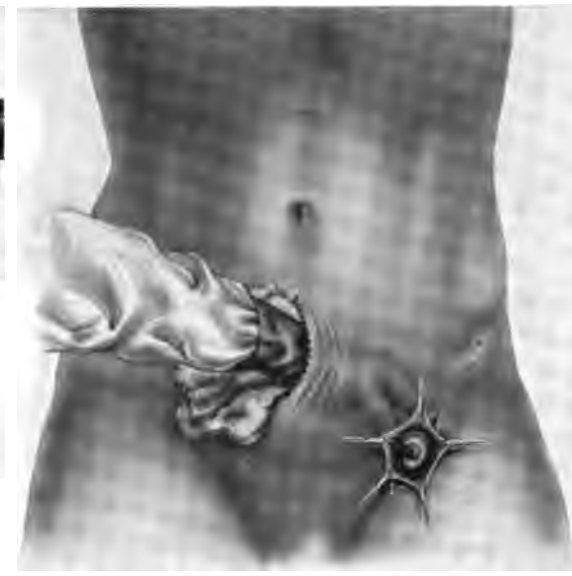


Fig. 29.

of the types of cases above considered should be as simple as possible. It is our custom unless there are special contra-indications to allow such patients to have all the water they desire. Strychnine is never used, and morphine is rarely needed.

Proctoclysis, tap water being used by the Murphy method, I have found of value. The Fowler position I have practically abandoned as a method of treatment, not only in the types of injuries above discussed, but in my other acute work.

In conclusion I wish to thank the fellows of the Association for their patience in listening to the lengthy presentation of this subject.

# CALCULOUS ANURIA, WITH REPORT OF TWO CASES[1]

By LINCOLN DAVIS, M. D., Boston
Assistant Visiting Surgeon, Massachusetts General Hospital

SUDDEN and total suppression of the urinary secretion as the result of obstruction by calculus is a serious and dramatic surgical emergency which requires prompt and intelligent treatment. It is by no means such a great rarity; the literature abounds in scattered case reports, and probably a majority of the experienced surgeons of this country have each had several cases. The American text-books, however, for the most part dismiss the subject with a scanty paragraph. It is a condition which any one of us is liable to run into at any time without warning and which we should be prepared to meet intelligently. The collated experience of others has brought out certain facts in regard to the condition which are interesting and important.

Anuria is a symptom which has been described by medical writers from the earliest times; its pathology, however, long remained in densest obscurity and is still far from being fully understood. Alpin in the sixteenth century was the first to call attention to anuria of strictly obstructive type.

The treatment in the early days was entirely expectant and a number of cases of calculous anuria are reported, in which spontaneous expulsion of the stone was followed by what the French call a urinary débacle and cure. Such happy results, however, were the exceptions to the melancholy general rule, and with the advancement in the art of surgery it was but natural that operative measures should be resorted to for relief in this dangerous and usually fatal condition. Guermonprez (1), a French surgeon, is credited with being the first to operate for calculous anuria, in 1870. He performed left lumbar nephrotomy, finding the kidney and pelvis greatly dilated and the ureter blocked by a stone, the right kidney being absent. Death resulted on the third day. Bardenheuer is credited with the first successful case, in 1882. Henry Morris, that brilliant pioneer of renal surgery, was an early operator for this condition. In his text-book of diseases of the kidney and ureter, he discusses the subject of calculous anuria in considerable detail. He collected, in 1898, 97 cases from the literature; in 48 of these no operation was performed, 10 recovering and 38 dying, a mortality of nearly 80 per cent. In 49 cases in which operation was performed the mortality fell to 51 per cent. Many operative cases have been published since Morris' compilation, with a steadily diminishing mortality. The mortality statistics depend largely upon the stage of the disease reached when surgical intervention was undertaken. Early writers counselled waiting until the fifth or sixth day of anuria before interfering surgically, with the hope of spontaneous relief. It was observed that a patient would often remain in comparative well being and comfort for five to six days, with total anuria, before the advent of uræmic symptoms. This relatively symptomless period was called the period of tolerance. Succeeding writers kept cutting down the period of waiting until the sound advice was pretty generally promulgated that it was better to operate at once. In recent times, with the advent of the cystoscope and ureteral catheter, a number of successful cases have been recorded which were treated by the ureteral catheter alone. These somewhat fortuitous results have encouraged certain authorities to advocate the use of the ureteral catheter as a means of treatment, at least as a preliminary measure. That the ureteral catheter has an important place in the diagnosis and treatment of this condition cannot be gainsaid, but that it will often be of permanent curative value is, I think, doubtful.

What is calculous anuria? Calculous anuria is the complete suppression of urinary secretion by obstruction of the renal outlet by one or more calculi. It occurs under the following conditions:

1. When a ureteral or pelvic calculus ob-

[1] Read before the Buffalo Academy of Medicine, December 2, 1913.

structs a congenitally single kidney, or one whose fellow has been removed by operation, or destroyed by disease.

2. When both kidneys are blocked by ureteral or pelvic calculi.

Many authorities maintain that anuria may, and does, occur under a third condition: so-called reflex calculous anuria, *i. e.*, that if one kidney is blocked by a calculus, a reflex inhibition may cause cessation of function of the opposite kidney, although the latter remain unobstructed. This is somewhat of an academic question which has been much argued pro and con; it is not, however, without practical importance, and I shall refer to it in some detail later.

The clinical aspects of calculous anuria with some of its diagnostic and operative pitfalls are well exemplified by two personal cases in which the final results were favorable. The clinical histories of these cases were as follows:

CASE 1. C. D. C., No. 178352 E. S. Mass. Genl. Hosp., 43 years, widow, brought to accident room at 3:15 P. M., September 17, 1911.

*Previous history.* Unimportant, except that she has had three previous attacks of anuria of less than one day's duration during last month. No pain or other urinary symptoms. Two days ago seized with sudden severe, knife-like pain in left loin, which radiated into groin; came on when she was going to bed. She vomited and felt chilly. Pain was not relieved by morphia. One-half hour after onset of pain felt as if something gave way in left loin, with slight relief. She had passed no urine since the night of September 15th. Pain has persisted but is less severe. Catheterized twice by local doctor, who obtained no urine. Bowels moved to-day, vomited yesterday.

*Examination.* Well developed and nourished woman. Pupils very small and react very slightly. Tongue coated, teeth false, throat negative. No adenopathy. Heart, soft systolic murmur at base. Lungs negative. Abdomen soft and distended. Liver edge two inches below costal margin in nipple line. In left loin there is a moderate amount of spasm and tenderness. No costovertebral tenderness. Knee-jerks present and lively. No œdema.

*Vaginal examination.* Negative, except for small polyp of cervix. Temperature 99°, pulse 70, respiration 22, white count 16,000. Patient catheterized, ʒii of urine obtained, sediment of which showed numerous leucocytes and small round cells, rare blood-corpuscles and granular casts. Patient was put to bed, given urotropin, fluids forced, and hot poultices applied to left loin. Catheterized next morning and no urine obtained. Patient states that her face feels swollen, no other signs or symptoms of toxæmia. X-ray taken, negative for stone in kidneys, ureters, or bladder. It was decided to operate without further delay. This was on Monday morning, ʒii of urine only having been obtained since the previous Friday evening, sixty hours. Left kidney exposed through a loin incision, found much enlarged, congested and purple in color. A nephrotomy was done, and when the pelvis was reached there was a gush of bloody urine estimated at several ounces. The pelvis and ureter were then explored digitally but no stone felt. There was considerable venous oozing from the cut surface of the kidney as well as from its capsule. Two small gauzes were packed into the nephrotomy wound and two large gauzes were packed about the kidney. Patient made a good recovery from ether. There was considerable staining of the dressing with a distinct urinous odor. In the afternoon of the day of operation the patient began to void urine naturally; on the third day after operation she voided 80 oz. On the fifth and sixth days she voided nothing, though there was constant desire to do so. Patient had considerable pain and appeared quite sick. There was slight œdema of the face. There was profuse urinary leakage from the wound. On the sixth day patient passed about 20 small stones, the largest of which was the size of a green pea. After that, urination became free and the amount draining from the wound very slight. On the thirteenth day the drainage from the wound, which had ceased, began again and the patient was unable to void. She finally passed a small stone on this day and another three days later. Normal urination had again established itself. Cystoscopy at this time showed a somewhat inflamed bladder with a dilated, ragged-looking left ureteral orifice. No sign of a right ureteral orifice could be found. There was no excretion of indigo-carmin during an observation of twenty minutes. Colorless urine, containing particles, was seen to issue from the left orifice at regular intervals. On the thirty-first day two more small stones were passed; stones were passed daily for the next five days. Patient was discharged to Waverley on the forty-ninth day; the wound healed solidly; there was no pain and the general health very good. The urine at this time was normal. I have seen the patient several times since and her health continues excellent; she has passed no more stones. A cystoscopic examination, made on February 13, 1913, showed a tiny slit in the position that corresponds to that of the right ureteral orifice; it remained absolutely inactive and it was impossible to engage a No. 6 ureteral catheter in it. The left orifice appeared active and normal.

CASE 2. J. F. F., No. 186395 E. S. Mass. Genl. Hosp., 27 years, single, machinist. This patient was admitted through the accident room at 1:15 P. M., December 5, 1912, from the Lakeville Sanatorium, with the diagnosis of anuria. Family history, several uncles and aunts died of tuberculosis. Previous history, diphtheria in childhood; tuber-

culosis of lungs since a year ago last October; has had five hæmorrhages; has no cough at present. Patient says he inhaled a loosened tooth into his lungs and coughed the tooth up eighteen months later. After raising the tooth there was no further cough or hæmoptysis. Habits good. Present illness. When a boy, was treated at Boston Emergency Hospital for blood in urine. No trouble from that time until nine months ago when he had pain for two days in the left kidney region. Urine stopped once or twice during this time, and finally, on the second day of the attack, he passed a stone. Pain has always been on the left side. Last August he had another attack, with vomiting. Passed no urine for a day, but finally passed a stone with entire relief.

Sunday night, December 1st, five days ago, began to have sharp pain in the left side, running down into penis. Has not passed a drop of urine since Monday morning, four days ago; appetite failed; frequent vomiting.

*Examination.* Well developed and nourished man, rather obese. Nervous and talkative. Mind clear. Breath smells of acetone. Eyes a little puffy. Skin pasty and moist. Mucous membranes pale. Pupils equal, regular, react normally. Teeth poor, some pyorrhœa. Tongue heavily coated, dirty white. Throat not remarkable. Dullness at right apex, lungs otherwise negative. Heart not enlarged, sounds rapid, regular. Soft systolic murmur heard best over pulmonic area. Abdomen full, tympanitic throughout. Tenderness in left costovertebral angle and slight tenderness along course of the ureter. Kidney not palpable. Both epididymes thickened. Knee-jerks normal. Rectal examination negative. Temperature normal. Pulse 90. Respiration 20. Immediate X-rays were taken, which showed a definite shadow low down in region of right ureter, other shadows in region of right kidney, questionable shadow in pelvis of left kidney.

*Cystoscopy.* Cystocope passed, bladder empty. Filled with boracic solution. Bladder not remarkable. Both ureteral orifices seen, the right one appearing swollen, reddened, and distorted. Unable to catheterize right ureter, thought to be partly due to abnormality of orifice and partly to faulty catheter. Left ureteral orifice readily catheterized and catheter passed to kidney pelvis with a scanty flow of clear urine, about ten drops. Catheter fastened in place and patient sent back to ward. The diagnosis at this time was calculous anuria, stone in right ureter, reflex anuria of left kidney. The ureteral catheter drained nothing during the night; the patient pulled it out before morning, but with a hypodermic of morphia passed a fairly comfortable night. There was no secretion of urine, however. More X-rays were taken in the morning, but without waiting for their development I decided on immediate operation. This was the beginnnig of the sixth day of complete anuria. The right kidney was exposed by an oblique incision in the loin. The kidney was found very small and lobulated, evidently destroyed by an old tuberculous process, ureter opened and found packed with caseous material. The pedicle of the kidney tied off and kidney removed. Ureter freed as far down as incision allowed, and removed, about 3½ inches, a cigarette drain placed to the stump of the ureter. The incision was then closed, the patient turned on the other side and the left kidney cut down by an oblique loin incision. The kidney was found much enlarged, congested, and purple. The edge of a retractor accidentally cut into the renal substance; this incision was enlarged and carried down into the pelvis. No stone could be felt by the finger. This wound was packed with gauze and the pelvis of the kidney and ureter freed from the outside; a small stone was distinctly felt at the pelvic outlet. The pelvis was opened but the stone had slipped out of touch. On account of the serious condition of the patient, a protracted search was not made. A bougie was passed from the pelvis to the bladder, without obstruction. A catheter was fastened into the pelvis of the kidney. The nephrotomy wound was packed with gauze; the wound of the parietes was partly closed in layers with catgut. Before the swathe was pinned, urine commenced flowing from the catheter freely. During the latter part of the operation the condition of the patient caused great anxiety. His color was bad and he stopped breathing several times, requiring artificial respiration. Patient returned to ward in poor condition. Responded to stimulation feebly. There was a very free flow of urine from the catheter in the renal pelvis and also into the dressing.

The specimen of the removed kidney consisted of a mere sac, filled with pultaceous material; the same material also filled the ureter.

The pulse, on the day after operation, rose to 160, and the man appeared desperately sick. The heart rate was counted at 194 by Dr. D. L. Edsall, who saw the case in consultation, and found acute dilatation of the heart, 6 cm. to the right, 12½ cm. to the left of midsternal line. There was some improvement after intravenous injection of strophanthin. There was a marked macular eruption over the entire body. During the next few days there was rapid improvement with very profuse secretion of urine. There was marked desquamation of the skin as the rash faded. In three weeks the wound had nearly closed and all urine was passed by urethra. Nothing had been seen of the stone. A series of very puzzling X-rays, although not conclusive, seemed to show a pretty constant shadow in the pelvis of left kidney. This evidence, in conjunction with the sudden reopening of the wound and discharge of urine on the fortieth day, decided me to reoperate and search for the stone, which I believed still lay somewhere in the pelvis of the kidney.

On January 15, 1913, an incision was made through the old scar. The kidney was freed with some difficulty. Palpation of the ureter and pelvis negative; a rubber-covered clamp was applied to the pedicle of the kidney and a nephrotomy done.

The pelvis was then most thoroughly searched for stone without result; a bougie was passed to the bladder without obstruction. A partly broken down lymph-gland lying near the ureter, which was at first thought to be a stone, removed. The peritoneal cavity was accidentally opened but immediately closed by suture. The nephrotomy wound was packed with gauze, the clamp removed, and the wound closed with drainage. The operation was started under spinal anæsthesia; this was satisfactory at first, but the traction necessary to free the kidney caused pain and ether was substituted for it and maintained to the end. There was again considerable shock after operation. The patient made a slow but steady convalescence and was discharged on February 19, 1913, to the Lakeville Sanatorium, in excellent condition, with a very small granulating wound in the left side, wound in right loin healed.

The final X-ray plates still showed a questionable shadow in the region of left kidney.

The patient has continued to improve since discharge and is now in excellent health. The urine is normal and the wounds are healed.

He was shown at the recent meeting of the American Urological Association in Boston.

These two cases are excellent examples of calculous anuria, and although the operations were in neither case all that might be desired, in that the stones were not found and removed at operation, yet the outcome in both was very satisfactory, and shows the paramount importance and value of drainage as a life-saving measure.

In the first of these cases we have, to the best of my knowledge and belief, a congenital solitary kidney blocked by a mass of small stones in the ureter, with resulting anuria. In the other case we have the active kidney blocked by a stone in the pelvis, with complete destruction of its fellow by an old tuberculous process.

In this latter case I read the signs and symptoms all wrong. The X-ray shadows in the region of the right ureter, the impossibility of catheterizing the right ureter, together with the ease of catheterizing the left, and the obtaining of a little normal urine from it, led me into the false belief that we had to do with a case of calculous obstruction of the right ureter and reflex anuria of the left kidney. The history of pain in the left side, with the muscular spasm and tenderness, should have indicated plainly enough that the obstruction was here. Both cases illustrate the fact that renal drainage is not only a life-saving procedure in these cases, but also by allaying ureteral spasm often permits of spontaneous passage of ureteral stones.

Since my experience with these two cases I have become much interested in the subject of calculous anuria, and particularly in the matter of reflex anuria.

A number of authorities support the theory of reflex inhibition of one kidney, when its fellow is suddenly obstructed, as by calculus, so-called reflex anuria. They admit, however, that such cases are rare.

Watson (2), in his paper before the International Urological Congress in Paris, in 1908, cited 17 cases of reflex calculous anuria out of 187 cases collected from the literature and analyzed by him. Watson estimated that in 20 per cent of the cases of calculous anuria there was obstruction of both ureters by calculus. He made a strong plea for simultaneous bilateral operation in appropriate cases. There was a very exhaustive consideration of anuria at this meeting by eminent world authorities. Many additional cases were reported; some as evidence of reflex inhibition, the majority of reports, perhaps, favoring the view that such a condition, though rare, yet really did exist.

Let us consider the evidence upon which the assumption of reflex inhibition rests. In the great majority of cases cited as examples of reflex calculous anuria, the unobstructed kidney is the seat of more or less advanced disease. These cases, it seems to me, should be thrown out, as the term reflex cannot strictly be applied to the failure of such a kidney. Let us state a hypothetical case. A patient has suffered from attacks of renal lithiasis with infection for a number of years and has passed a number of calculi. We know that in such cases the disease is usually unilateral at first with a very strong tendency to become eventually bilateral. We will assume that at the time the patient comes under observation the left kidney has been considerably damaged by repeated attacks of lithiasis, accompanied with infection, resulting in a condition of pyelonephritis, although at the moment it is entirely clear of stones. The right kidney, on the other hand,

has but recently become the habitat of a calculus, and but little damage has as yet been done to its parenchyma; it is the active organ of the pair, doing three-quarters of the work of elimination for the body. The single small calculus in the right kidney suddenly drops into the renal pelvis and becomes engaged there, blocking its outlet and completely obstructing the outflow of urine. Secretion of the right kidney ceases and all the work of urinary elimination of the body falls upon the damaged left kidney. This feeble and diseased organ is unable to respond to the burden suddenly thrown upon it; it is overwhelmed with work and fails to functionate, with resulting anuria. Why invoke in such a case the complicated phenomenon of reflex action? Is it not purely a case of functional exhaustion? When the stomach is overloaded with indigestible food the secretory glands rebel at the impossible task, digestion ceases, and the overload is thrown off by vomiting. An overloaded kidney cannot relieve itself by vomiting, and if its function is already handicapped by disease it is soon forced to a point beyond which it cannot go, function ceases, with resulting suppression. The suppression of function of a single diseased kidney, or of two such for that matter, as the result of an overwhelming burden being cast upon it, or them, will of course be readily granted by the advocates of reflex inhibition. But they will object that renal failure of such a nature is accompanied or preceded by all the well-known symptoms and signs of uræmia, while in these cases of calculous anuria there is a striking lack of any such signs for from three to six days after the anuria has become complete, the so-called period of tolerance. This is undoubtedly true in the vast majority of cases which is generally conceded to consist of those in which the entire functionating renal substance has been suddenly put out of commission by calculous obstruction of the only active kidney, or of both kidneys. It is a striking fact, however, that in the few cases of anuria recorded in which the second kidney was found unobstructed but diseased uræmic symptoms supervened early. Cases of Marcille and Leonté (3).

If a structure is supported on two pillars, and one of these, the stronger of the two, is suddenly knocked away, so that the whole weight is thrown on the remaining weaker one, whose strength is unequal to the burden, its collapse is not spoken of as a reflex act.

Fortunately for the human economy, either kidney alone is amply capable of carrying on the normal work of elimination for the body, if sound or nearly sound. At just what degree of unsoundness of a single kidney renal failure ensues it is impossible to determine, many complex factors entering into the problem.

It seems to me that the term reflex should be applied only to such cases as those in which the supposedly inhibited organ is organically sound. If one accepts this proposition, the problem is simplified and the number of cases becomes considerably diminished. Watson's seventeen cases, for example, are immediately reduced to seven, and careful scrutiny of these raises the question whether other interpretations than reflex action are not applicable.

Donnadieu (4) in 1895 analyzed forty-six cases of calculous anuria, with the following results: In six cases there was absence of the second kidney; in thirteen cases the obstruction was double; in twenty-three cases the function of the second kidney was suppressed as the result of traumatism in one, cystic degeneration in one, lithiasis in twenty-one, leaving four cases in which he considered the suppression of the second kidney as due to reflex action. In these four cases he admits there may have been some lesion present in the inhibited organ.

Huck collected, in 1904, sixty-one cases from the literature which had appeared since Donnadieu's work. Of these, thirty offered sufficiently explicit data for analysis. He found thirteen cases of bilateral obstruction of the ureters; four cases of obstruction of one ureter, the other kidney being completely atrophied; three cases of obstruction of one ureter, the other kidney being congenitally absent; five cases of obstruction of one ureter, the other kidney having been nephrectomized; three cases of obstruction of one ureter, the other kidney presenting no

obstruction, verified at autopsy. These are cases of Marcille, Leonté, and Albaran. In two of these latter cases there was diffuse nephritis of the unobstructed kidney. This leaves but one case out of thirty in which there is question of reflex inhibition of a sound kidney. And in this case exact histological data as to the condition of the unobstructed kidney are lacking; it is merely stated that it was enlarged and congested.

In fact, as far as I have been able to learn, no cases have been reported of so-called reflex calculous anuria backed by convincing post-mortem and histological evidence of the soundness of the unobstructed kidney. This is an essential desideratum for acceptance of the theory.

As Legueu (5) points out, kidneys which appear macroscopically normal may be totally degenerated and even a slight proliferation may suffice to definitely compromise their function.

Let us consider next the purely clinical evidence, some of which seems at first glance to be quite strong. These cases divide themselves into two groups—those in which evidence of the return of function of the unobstructed but inhibited organ is gained by the use of the ureteral catheter and the flow of normal urine and those in which, after a nephrotomy with drainage of bloody urine from the wound, the passage of large amounts of clear urine from the bladder is looked upon as of like import.

These cases are, of course, very suggestive, especially when backed by corresponding X-ray evidence, as a few of them have been, yet they are susceptible of other interpretations. In the first place the obtaining of normal urine is not conclusive evidence that the kidney from which it comes is normal. The kidney may be congenitally small, of infantile type, or atrophied and incapable of carrying on alone the work of elimination for the body, and yet secrete a small amount of normal urine. Again, many cases of considerable degrees of interstitial nephritis are undetectable from urinary analysis. Furthermore, the ureteral catheter may dislodge a stone and obtain practically normal urine, as undoubtedly happened in my second case. A frequent source of error is ureteral spasm provoked by a small calculus. The ureteral spasm yields to narcosis and allows urine to pass although the stone still remains in the ureter. Three instructive cases of this kind are cited by Huck, two reported by Bruch, and one by Weiss, in which urine was voided naturally after unilateral nephrotomy for calculous anuria, and yet double ureteral obstruction by calculus was proved later at autopsy. A calculus acting as a ball valve might also be mistaken for reflex inhibition. Ureteral spasm practically always accompanies the passage of a stone down the ureter and is the cause of the accompanying renal colic. It is associated with anuria of the corresponding kidney probably in most cases. I had occasion recently to observe it in a case of right ureteral fistula, in which a stone became engaged in the opposite ureter with entire cessation of entrance of urine into the bladder for thirty-six hours. The vagaries of renal colic are well known. A stone may be impacted in the ureter tightly, without colic and without anuria; ureteral spasm may relax at any moment and allow the passage of the stone, or allow the passage of urine, the stone remaining in the ureter.

A case is recorded of a patient with anuria falling out of bed while writhing in the agony of renal colic, followed by immediate cessation of pain and resumption of normal urinary secretion.

Under these circumstances the cases of Israel (6), Kreps (7), Imbert (8), Rovsing (9), and others in which the reëstablishment of urinary secretion in the supposedly unobstructed but inhibited kidney was shown by ureteral catheterization, although very suggestive, cannot be considered as wholly convincing. The same applies to the case of Pousson (10) and others of like nature.

Legueu maintains that inhibition does not enter into the problem of calculous anuria at all; that it is not inhibition that arrests secretion of the obstructed kidney, but increased tension, for once the kidney is opened, although the calculus remains untouched, secretion is resumed. It is the letting up of renal tension which allows the kidney to resume function.

Experimental evidence of the renorenal reflex inhibition due to obstruction of a ureter is scanty. Götzl (11), whose work has been extensively quoted by advocates of the reflex theory, was able to produce temporary anuria in three out of twelve experiments on dogs by obstruction of a single ureter. His results, however, are vitiated to a certain extent by the fact that the dogs used were narcotized by large doses of morphine, so that there was a toxic element present. I cannot find that his experiments have been substantiated by others. Dr. J. D. Barney of Boston has done considerable experimental work on the ligature of the ureter in animals. He reports thirty-three cases of unilateral ligation of the ureter—seven in rabbits and twenty-six in dogs—without the occurrence of anuria in a single case. He noted a temporary diminution of the urine secreted from the unobstructed side for a day or two, followed by a compensatory hypersecretion later. He found varying degrees of hydronephrosis in the obstructed kidney in all cases, indicating a rise of intrarenal pressure. Barney also collected sixty-two authentic cases of sudden and complete occlusion of the ureter by ligature or clamp in the course of operations on human beings. Of these sixty-two cases the ureteral injury was unilateral in forty-six and bilateral in sixteen, the large majority occurring in the course of a hysterectomy, vaginal or abdominal. Anuria occurred in all the bilateral cases, as was to be expected. In the forty-six unilateral cases anuria occurred but once, the patient dying after thirty-six hours of acute uræmia. Data as to the condition of the other kidney in this case are entirely lacking.

In summing up, then, the subject of reflex calculous anuria, it can fairly be stated that while the possibility of reflex inhibition of a sound unobstructed kidney cannot be absolutely denied, convincing post-mortem, clinical, and experimental proof is still lacking.

It seems unreasonable to ascribe to the mysterious and little understood phenomenon of reflex inhibition the failure of an unsound but unobstructed kidney to secrete, when its more active fellow is suddenly obstructed by calculus, when the simpler phenomenon of functional failure under overload is adequate explanation.

For all practical purposes, then, calculous anuria should be considered a purely mechanical problem and treated as such. The diagnosis having been made, it should be assumed that either only one actively functionating organ exists, which is blocked, or that there is blocking of both kidneys. The indication is to unblock at the earliest possible moment. The diagnosis is usually self-evident and needs but little consideration. The X-ray and cystoscope are of the greatest aid in locating the sites of obstruction and indicating the point of attack. The cystoscope and ureteral catheter have of late years been likewise of therapeutic value in many cases. When the condition of the patient is not alarming, it is undoubtedly wise as a preliminary measure to attempt the dislodging of a ureteral stone, or at least the allaying of ureteral spasm by this means, and it will occasionally suffice in itself to obtain a cure. In desperate cases at once, and in all other cases when the ureteral catheter fails to give permanent relief, operative measures must be resorted to.

The ideal procedure is not only to relieve the tension of the obstructed kidney, but to remove the obstruction as well, and this can often be done when the stone is readily accessible at the outlet of the kidney pelvis. When the stone is impacted in the lower end of the ureter, it will seldom be wise to undertake its removal during anuria. It is safer to be content with simple drainage of the kidney, which will often result by relief of intrarenal pressure, and the allaying of ureteral spasm, in spontaneous passage of the stone. If not, it can be removed later.

Nephrotomy is generally advocated as the method of choice because it is quickly and easily done, secures good drainage, and permits of removal of any stone found in the pelvis of the kidney. It has but one disadvantage, which to me is a very serious one, the danger of hæmorrhage. Pyelotomy is certainly safer, gives equally good drainage, and ample access to any occluding stone of moderate size. Where the kidney is very much enlarged it might be found to be some-

what more difficult. I should personally attempt it in another case. If upon cutting down upon one kidney it is found to be functionally useless, or even considerably damaged, the other kidney should be immediately explored in the hope of releasing whatever functionating renal substance may be imprisoned there. The simultaneous bilateral operation has been ardently advocated by Watson and deserves recognition in appropriate cases. If bilateral obstruction is found to occur in twenty per cent of all cases, this fact would seem to afford a substantial basis for the operation.

In the few cases of anuria recorded in which one kidney was obstructed and the other diseased but apparently unobstructed, incision and drainage of the unobstructed organ has afforded little or no relief. This is in accord with the disappointing results obtained from nephrotomy in urinary suppression due to causes other than stone, such as nephritis, corrosive sublimate poisoning, etc.

In conclusion I wish to lay emphasis on the following points:

1. Analysis of cases of calculous anuria recorded in the literature shows that at least in ninety per cent either only one actively functionating organ existed, which was blocked, or that there was blocking of both kidneys.

2. The few cases reported as examples of reflex inhibition of an unobstructed but more or less diseased kidney, as the result of calculous obstruction of its fellow, are to be explained more rationally as the functional failure of an overloaded unsound organ.

3. Convincing post-mortem and histological evidence of reflex inhibition of a sound kidney, as the result of calculous obstruction of its fellow, is lacking.

4. Convincing clinical and experimental evidence is likewise lacking.

5. From a practical point of view, then, calculous anuria should be considered and treated as a purely mechanical problem.

6. The therapeutic employment of the ureteral catheter should be restricted to a tentative use in mild cases only.

7. Operation should be resorted to at once in all urgent cases, the indication being to relieve obstruction, pyelotomy when practicable to be preferred to nephrotomy. Removal of the stone is an ideal to be attained whenever possible without undue prolongation of the operation.

8. Bilateral operation is indicated whenever the kidney first cut down upon seems inadequate by itself to sustain the work of elimination of the body. It naturally follows from this that the bilateral operation should be performed whenever the kidney first cut down upon is apparently found unobstructed.

REFERENCES


1. Morris, Henry. Hunterian Lectures, 1898, Surgical Diseases of Kidney and Ureter.
2. Watson, F. S. Ass. Internat. d'urol., 1908.
3. Huck. L'Anurie Calculeuse. Thèse de Nancy, 1904.
4. Donnadieu. Thèse de Bordeaux, 1895.
5. Legueu. Ass. Internat. d'urol., 1908.
6. Israel, J. Chir. Klin. d Nierenkrankheiten, 1901. Cases 192.72 and 190.70.
7. Kreps. St. Petersb. med. Wchnschr., 1903, v, 545.
8. Imbert. Ass. Franc. d'urol., 1905, p. 582. Compte Rendu de l'Ass. Franc. d'urol., 1906, p. 508.
9. Rovsing. Ass. Internat. d'urol., discussion, 1908.
10. Pousson. Bull. Med., 1900, p. 1157.
11. Götzl. Deutsche Med. Wchnschr. No. 33, p. 254. Prag. med. Wchnschr., 1901, No. 18, p. 220.
12. Barney, J. D. The Effects of Ureteral Ligation, Experimental and Clinical. Surg., Gynec. & Obst., 1912, Sept., 290.

# FINAL RESULTS (AFTER FIVE YEARS) IN 192 PATIENTS OPERATED UPON FOR ECTOPIC PREGNANCY; WITH SPECIAL REFERENCE TO SUBSEQUENT UTERINE AND REPEATED ECTOPIC PREGNANCIES[1]

By RICHARD R. SMITH, M. D., Grand Rapids, Michigan

TO learn what becomes of our patients operated upon for ectopic pregnancy, with the main idea of helping to establish a more rational basis for judgment as to whether in any given case we shall or shall not at the time of operation remove the opposite tube, has been the object of this inquiry.

If I may judge from a considerable amount of correspondence in my possession and from the numerous conversations I have had with surgeons, it would seem that a good deal of uncertainty exists as to the future course of such patients after their recovery from operation, particularly as to the frequency of subsequent normal pregnancies or a repeated ectopic one. This is quite excusable, for but few writers have busied themselves with this phase of the problem, and few with large experience have seemed to follow their cases for long periods. For the most part, surgeons have seemed to believe that normal pregnancies were very common and that repetitions were so infrequent as to be of little importance and, therefore, to warrant a uniformly conservative attitude in preserving whenever possible the childbearing function.

Because of this commonly held opinion, surgeons have, it appears, based their treatment of the opposite tube largely upon its apparent condition. It would seem that the general rule followed has been to examine it whenever the circumstances permitted, to remove it (and occasionally other diseased pelvic structures) if it were hopelessly closed or diseased, and to leave it if it appeared normal or capable of becoming so. Until recently my own course of action has been in accordance with this plan. However, after a more careful study of repeated ectopic pregnancy, I have somewhat modified my opinion and have come to the belief that whereas the general rule to preserve the opposite tube should usually be followed, it may be wiser to occasionally remove it, for repetitions have been frequent enough in such tubes to show us that in spite of its appearance we cannot safely prophesy as to its capabilities; *i. e.* whether it will normally transmit the ovum or not.

If I may judge from the literature and from my own experience, there is no one type of tube seen at such operations which from its appearance would seem on the one hand to make it especially disposed to a further ectopic pregnancy and give a sufficient reason for its removal; or, on the other hand, to warrant our safely assuming that such an accident would not recur and that a normal pregnancy, if any, would take place.

Whereas, under such circumstances, we are unable to correctly judge as to the capabilities of a patulous tube by its appearance, we do know that the woman who has once had an ectopic pregnancy is apt to repeat the process on the opposite side whenever the tube is patulous at the time of operation or capable of becoming so. The frequency with which this occurs is of greatest importance in making our decision in any given case as to whether it shall or shall not be left. Of fully equal importance are the facts concerning the frequency of subsequent normal pregnancies.

As to the frequency of normal pregnancies following an ectopic one, I did not have access at the time I began this study to the excellent work of Essen-Möller,[2] but I was led to believe from my own experience and from the little information that I could obtain from several others that their number was less than we had commonly supposed.

Essen-Möller, in his paper published two

[2] Essen-Möller. L'Obstetrique, Par., 1911, iv, 249.

[1] Read before the Section on Obstetrics, Gynecology and Abdominal Surgery, American Medical Association, Minneapolis, June 17, 1913.

years ago, deals with this question. Of his fifty-six cases he rules out seventeen:

One 49 years of age, seven operated that year, five in which both tubes were removed, two who died of tuberculosis, and two in which a microscopical examination of the tube showed no chorionic villi.

Of the remaining thirty-nine cases, eighteen (46 per cent) have had uterine pregnancies (seventeen with living children). He quotes Prochownik,[1] who had twenty-five normal pregnancies out of fifty-seven women, or 43.8 per cent, and Engström,[2] twenty out of forty-three, or 46.5 per cent. He expresses himself unqualifiedly in favor of not only preserving the opposite tube in all cases where it is not badly diseased, but of doing everything possible in rendering it capable of functionating normally. His own experience with repeated ectopic pregnancy has been small (two out of thirty-nine) and he regards this as a negligible factor. I do not believe he is entirely correct in this opinion, but that it is not only necessary to consider the frequency of subsequent normal pregnancies, but of repeated ectopic ones as well.

In gathering statistics two years ago for a paper on repeated ectopic pregnancy,[3] I found that there had been one hundred and thirteen recurrences in 2,998 cases gathered from the clinics in this country and abroad (a little less than 3.8 per cent). It was evident that this estimate was too low — first, because in large cities with a moving population it is almost impossible to follow patients for any extended period of time; second, no allowance was made for the nature of the operation performed; third, the age and the civil condition of the patient afterwards were not considered; and, fourth, the very important matter of lapse of time following operation was entirely left out of the account. It seemed reasonable to suppose that if our cases could be followed for a considerable period of time, and if we rightfully ruled out those in which for any reason further pregnancy was rendered impossible and confined ourselves to the ones in which a patulous tube was left, the percentage of recurrences would be much higher than this.

In order to obtain more accurate data, I have off and on for the past two years been carrying on a correspondence with a considerable number of surgeons in this country, and have obtained, from those men who were able to give me satisfactory statistics, an account of 192 patients that were operated upon more than five years ago.[4] I have asked these surgeons to give me the date of the operation, the age and civil condition at the time of operation, and to tell me what the condition of the affected tube was and what was done with it, and of the unaffected tube and how it was disposed of. They have obtained from the patients themselves, or through some reliable source, the facts as to subsequent uterine pregnancies, and whether they have had a repeated ectopic one. Their civil condition following operation was also noted and, in a general way, their present state of health and whether they had had any pelvic condition necessitating further operation. It is the result of this correspondence that I wish to give you. It is necessary first of all that any group of this kind be fairly representative of ectopic cases as a whole. I have included all cases operated five years ago or more *which have been traced* and in which the essential details were complete. I have thrown out those operated on less than five years ago, those that had not been definitely traced, those in which the essential details were incomplete, and a few isolated cases sent me that had been brought to the reporter's attention by some unusual incident, and which I did not think it fair to include.

I wish here to express my gratitude to those men who so willingly contributed to this work. No one except those who have undertaken it appreciates the amount of time, effort, and patience that the following up of old patients requires, and that they have done so willingly speaks well for the courtesy of the American

[1] Prochownik. Wien. med. Wchnschr., 1895, xlv, 1266; München. med. Wchnschr., 1900, lxiv.

[2] Engström. Mitt. u. d. gynak. Klin., i, 327.

[3] Smith, R. R. Am. J. Obst., N. Y., 1911, lxiv, 401.

[4] The five-year interval was selected rather arbitrarily. Had I selected a much longer one the number of cases reported would have been so reduced as to make the statistics lose much of their value. To make them absolutely accurate each case would have to be followed to the menopause, a thing which at the present time is manifestly impossible. For a first subsequent uterine pregnancy to occur later than five years following an ectopic one is rare. Also in 145 cases in which the interval between the two ectopics was given, I found that the average was almost exactly thirty months. In only fifteen instances was the interval longer than five years.

**EXPLANATION OF TABLE.**—The year of the operation given—month and day omitted. All 1908 cases were before June of that year. No special effort made to obtain reports on previous pregnancies and abortions—they are recorded as given. The year of a subsequent ectopic, pregnancy given whenever such was recorded. Civil condition following operation remained the same as far as was recorded, except when otherwise stated.

**ANSPACH, DR. BROOKE M., Philadelphia, Pa.**

| No. | Date | Age | Prev. Preg. | Prev. Abort. | Condition and Disposal Opposite Tube | Condition and Disposal Affected Tube | Subsq. Preg. | Subsq. Ect. | Present Condition |
|---|---|---|---|---|---|---|---|---|---|
| 1 | '03 | 28 | ? | ? | Not noted; emergency op. retained | Ruptured; removed with ovary | 0 | 0 | Cystic mass back of uterus in cul-de-sac size of egg |
| 2 | '08 | ? | ? | ? | L. hydrosalpinx; removed leaving ovary | Ruptured; removed with ovary | 0 | 0 | Health good |
| 3 | '08 | 35 | ? | ? | Not recorded; retained | Unruptured; removed | 3 | 0 | Health good |

**BACON, DR. C. S., Chicago, Illinois**

| No. | Date | Age | Prev. Preg. | Prev. Abort. | Condition and Disposal Opposite Tube | Condition and Disposal Affected Tube | Subsq. Preg. | Subsq. Ect. | Present Condition |
|---|---|---|---|---|---|---|---|---|---|
| 4 | '93 | 28 | 1 | 0 | Removed | Ruptured; removed | 0 | 0 | Fair; neurotic |
| 5 | '97 | 28 | 0 | 0 | Normal; not removed | Ruptured; removed | 1 abort. 3 ch. | 0 | Good |
| 6 | '01 | 25 | 0 | 1 | Not recorded; retained | Ruptured; removed | 1 ch. | 0 | Good |
| 7 | '02 | 32 | 2 | 0 | Retained; not recorded | Ruptured; removed | 0 | 0 | Good |
| 8 | '98 | 30 | 1 | 0 | Not noted; vaginal op. | Ruptured; infected; removed | 0 | 0 | Fair; neurotic |
| 9 | '97 | 34 | 1 | 0 | Not noted; vaginal op. | Ruptured; removed; vaginal drainage | 0 | 0 | Fair; neurotic |

**BALLIN, DR. MAX, Detroit, Michigan**

| No. | Date | Age | Prev. Preg. | Prev. Abort. | Condition and Disposal Opposite Tube | Condition and Disposal Affected Tube | Subsq. Preg. | Subsq. Ect. | Present Condition |
|---|---|---|---|---|---|---|---|---|---|
| 10 | '06 | 22 | ? | ? | Good; not removed | Tube and ovary removed | 0 | 0 | Good |
| 11 | '05 | 27 | ? | ? | Good; not removed | Ruptured; tube and ovary removed | 1 | 0 | Good |
| 12 | '07 | 23 | 1 | ? | Good; not removed | Ruptured; removed | 1 | 0 | Good |
| 13 | '07 | 30 | 0 | 2 | Healthy; not removed | Broken; removed | 0 | 0 | Good |
| 14 | '07 August, 1908, | 25 | 1 | ? | Good; not removed | Perforated; removed right adnexia removed for cystic condition and | 0 | 0 | Good salpingitis. |

**BARRETT, DR. CHANNING W., Chicago, Illinois**

| No. | Date | Age | Prev. Preg. | Prev. Abort. | Condition and Disposal Opposite Tube | Condition and Disposal Affected Tube | Subsq. Preg. | Subsq. Ect. | Present Condition |
|---|---|---|---|---|---|---|---|---|---|
| 15 | '06 | 33 | 0 | ? | Adherent and thickened; not removed | Ruptured; removed | 0 | 1 four years later | Good |
| 16 | '08 | 31 | 2 | ? | Slightly inflamed; not removed | Ruptured; removed | 1 | 0 | Good |
| 17 | '04 Four years later | 29 | 2 | ? | Old adhesions; not removed | Ruptured; abscess; six mos. pregnancy removal of right tube and ventral hernia | 0 | 0 | Illeus following operation; drainage; recovery |

**BISSELL, DR. DOUGAL, New York, N. Y.**

| No. | Date | Age | Prev. Preg. | Prev. Abort. | Condition and Disposal Opposite Tube | Condition and Disposal Affected Tube | Subsq. Preg. | Subsq. Ect. | Present Condition |
|---|---|---|---|---|---|---|---|---|---|
| 18 | '07 | 28 | 1 | ? | Engorged; not removed | | 0 | 0 | Good health |
| 19 | '07 | 46 | 8 | ? | Normal; not removed | Small gestation sac in middle of left tube | 0 | 0 | Good health |

**BOISE, DR. EUGENE, Grand Rapids, Michigan**

| No. | Date | Age | Prev. Preg. | Prev. Abort. | Condition and Disposal Opposite Tube | Condition and Disposal Affected Tube | Subsq. Preg. | Subsq. Ect. | Present Condition |
|---|---|---|---|---|---|---|---|---|---|
| 20 | 20 yrs. ago | 25 | ? | ? | Healthy; not removed | Removed | 0 | 0 | Health good |

**BOLDT, DR. HERMAN J., New York, N. Y.**

| No. | Date | Age | Prev. Preg. | Prev. Abort. | Condition and Disposal Opposite Tube | Condition and Disposal Affected Tube | Subsq. Preg. | Subsq. Ect. | Present Condition |
|---|---|---|---|---|---|---|---|---|---|
| 21 | '05 | 26 | ? | ? | Not removed | Removed | 1 | 0 | No ill effects |

**BRETTAUER, DR. JOS., New York, N. Y.**
(Investigated and reported by Dr. Jellinghaus)

| No. | Date | Age | Prev. Preg. | Prev. Abort. | Condition and Disposal Opposite Tube | Condition and Disposal Affected Tube | Subsq. Preg. | Subsq. Ect. | Present Condition |
|---|---|---|---|---|---|---|---|---|---|
| 22 | '02 | 26 | 3 | 0 | Normal; not removed | Ruptured; tube and ovary removed | 1 | 0 | Good |
| 23 | '02 | 38 | 8 | 0 | Diseased; tube and ovary removed | Ruptured; tube and ovary removed | 0 | 0 | Good, except menopause symptoms |
| 24 | '01 | 29 | 1 | 0 | Normal; not removed | Ruptured; tube and ovary removed | 0 | '02 | Good except menopause symptoms |

**BRETTAUER, DR., JOS., New York, N. Y. (Continued)**

| No. | Date | Age | Prev. Preg. | Prev. Abort. | Condition and Disposal Opposite Tube | Condition and Disposal Affected Tube | Subsq. Preg. | Subsq. Ect. | Present Condition |
|---|---|---|---|---|---|---|---|---|---|
| 25 | '03 | 25 | 0 | 0 | Normal; not removed | Ruptured into broad ligament salpingoophorectomy, myomectomy and suspension | 1 abort. 3 ch. | 0 | Good |
| | Infl | ame | d fi | broi | d following rece | nt delivery. | | | |
| 26 | 99 | 27 | 1 | 0 | Normal; not removed | Unruptured; tube and ovary removed | 0 | '03 | Good except menopause symptoms |
| 27 | '04 | 24 | 0 | 2 | Normal; not removed | Ruptured; tube only removed | 0 | 0 | Good health |
| 28 | '04 | 26 | 0 | 0 | Normal; not removed | Unrupt'd; tube only removed | 2 ch. | 0 | Good health |
| 29 | '03 | 27 | 1 | 2 | Inflamed; tube and ovary removed | Ruptured; tube and ovary removed | 0 | 0 | Good |
| | Hys | tere | c t o | my. | | | | | |
| 30 | '04 | 27 | 1 | 0 | Normal; not removed | Unruptured; tube only removed | 2 ch. | 0 | Good |
| 31 | '04 | 32 | 4 | 1 | Ovary cystic; tube adherent; tube and ovary removed | Cystic; pelvic peritonitis; tube distended | 0 | 0 | Good |
| | Pan | -hys | tere | c t o | my. | | | | |
| 32 | '02 | 27 | 2 | 0 | Normal; left intact | Ruptured; tube and ovary removed | 0 | '05 | Good |
| 33 | '06 | 31 | 0 | 1 | Norma; not removed | Unruptured; tube and ovary removed | 0 | 0 . | Health good except prolapse |
| 34 | '05 | 30 | 1 | 0 | Atrophied and nodular; not removed | Ruptured; tube and ovary removed | 0 | 0 | Good health |
| 35 | 05 | 23 | 0 | 0 | Normal; not removed | Ruptured; tube and ovary removed | 0 | 0 | Good |
| 36 | '06 | 23 | 0 | 1 | Normal; removed | Ruptured; tube and ovary removed | 1 | 0 | No ill effects |
| 37 | '06 | 38 | 1 | 4 | Tube infected; dermoid ovary; both removed | Ruptured; tube and ovary removed | 0 | 0 | Menopause symptoms; no other ill effects |
| 38 | '06 | 24 | 0 | 0 | Normal; not removed | Ruptured; tube only removed | 1 | 0 | Health good |
| 39 | '06 | 39 | 7 | 0 | Vaginal section | Hemactocele | | | No ill effects |
| 40 | '02 | 26 | 1 | 0 | Inflamed; tube only removed | Ruptured; tube only removed | 0 | 0 | No ill effects |

**BRETTAUER, DR. JOS., New York, N. Y. (Continued)**

| No. | Date | Age | Prev. Preg. | Prev. abort. | Condition and Disposal Opposite Tube | Condition and Disposal Affected Tube | Subsq. Preg. | Subsq. Ect. | Present Condition |
|---|---|---|---|---|---|---|---|---|---|
| 41 | '03 | 23 | 1 | 0 | Cyst of ovary removed | Ruptured; tube and ovary removed | 0 | 0 | Menopause symptoms; flushes, etc., but continues to menstruate |
| 42 | '02 | 21 | 1 | 1 | Normal; not removed | Ruptured; tube and ovary removed | 3 | 0 | Good health |
| 43 | '03 | 27 | 1 | 0 | Normal; removed; panhysterectomy | Ruptured; intramural | 0 | 0 | Good except menopause symptoms |
| 44 | '97 | 26 | 2 | 0 | Vaginal section neither tube inspected; nothing removed | | 0 | 04 | Excellent |
| | 1904 | ; Tu | beat | site | of old ectopic se | at of hydrosalpi | nx; bo | th rem | oved |
| 45 | '04 | 38 | 1 | 1 | Normal: not removed | Unruptured; tube and ovary removed | 0 | 0 | Excellent |
| | Wid | ow si | nce | '08 | | | | | |
| 46 | '06 | 34 | 6 | 3 | Not noted | Ruptured; removed | 0 | '07 | Excellent |
| 47 | '05 | 27 | 2 | 1 | Tube removed four months before for inflammation; now has follicular cysts | Ruptured; tube and ovary removed | 0 | 0 | Good |
| 48 | '06 | 30 | 2 | 1 | Normal | Unruptured; tube and ovary removed | 0 | 0 | Good |
| 49 | '06 | 34 | 5 | 0 | ? | Ruptured; tube and ovary removed | 0 | 0 | Good |
| 50 | '05 | 30 | 5 | 0 | Normal; not removed | Ruptured; tube and ovary removed | 1 | 0 | Good |
| 51 | '02 | 35 | 2 | 1 | Normal; not removed | Ruptured; tube and ovary | 0 | 0 | Developed pelvic exudate left side soon after operation; conservative treatment; now o. k. except occasional pain left side |

**CURRIER, DR. ANDREW F., New York, N. Y.**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 52 | '02 | 25 | 3 | 0 | Probably good from subsequent history | Not recorded | 2 ch. 1 still born 3 abort. | '12 | Health good |

**CURRIER, DR. ANDREW F., New York, N. Y. (Continued)**

| No. | Date | Age | Prev. Preg. | Prev. Abort. | Condition and Disposal Opposite Tube | Condition and Disposal Affected Tube | Subsq. Preg. | Subsq. Ect. | Present Condition |
|---|---|---|---|---|---|---|---|---|---|
| 53 | '96 | 32 | 2 | 1 | Pus tube; removed | Tumor behind uterus; uterus and tube removed | 0 | 0 | Health good; operated in 1899 for ventral hernia following operation for ectopic |
| 54 | '97 | 30 | 1 | 0 | Normal; not removed | Ruptured; removed | 1 ch. twins | 0 | Good |
| 55 | '98 | 26 | 0 | 1 | Bound down by adhesions; tube and ovary removed | Tumor in tube; tube and ovary removed | 0 | 0 | Health good, except menopause symptoms |
| 56 | '04 | 35 | 1 | 0 | Enlarged; tuberculous<br>Both tubes and | Tube and ovary adherent; tumor in proximal half ovaries remove d | 0 | 0 | Health good as far as known |

**DAVIS, DR. EDW. P., Philadelphia, Pa.**

| No. | Date | Age | Prev. Preg. | Prev. Abort. | Condition and Disposal Opposite Tube | Condition and Disposal Affected Tube | Subsq. Preg. | Subsq. Ect. | Present Condition |
|---|---|---|---|---|---|---|---|---|---|
| 57 | '02 | 23 | 0 | ? | Apparently healthy; not removed | Ruptured; removed | 0 | 0 | Excessively fat and for some time had menorrhagia; general health been much improved by the use of thyroid extract and tonic does of strychnia |

**DE LEE, JOS. B., Chicago, Illinois**

| No. | Date | Age | Prev. Preg. | Prev. Abort. | Condition and Disposal Opposite Tube | Condition and Disposal Affected Tube | Subsq. Preg. | Subsq. Ect. | Present Condition |
|---|---|---|---|---|---|---|---|---|---|
| 58 | '06 | 28 | 1 | ? | Normal; not removed | Stump left open | 0 | 0 | No ill effects |
| 59 | '05 | 32 | 3 | | Apparently normal; not removed | Stump left open | 1 | 0 | No ill effects |

**DOANE, DR. PHILIP SCHUYLER, Chicago, Illinois**

| No. | Date | Age | Prev. Preg. | Prev. Abort. | Condition and Disposal Opposite Tube | Condition and Disposal Affected Tube | Subsq. Preg. | Subsq. Ect. | Present Condition |
|---|---|---|---|---|---|---|---|---|---|
| 60 | '01 | 27 | 1 | m'y | Apparently normal; not removed | Ruptured; removed | abort. sev'al times | 0 | Good |
| 61 | '03 | 25 | 3 | 1 | Apparently normal; not removed | Ruptured; removed | 1 | 0 | Good |
| 62 | '04 | 28 | 2 | 1 | Apparently normal; not removed | Ruptured at outer third; removed | 0 | 0 | Good |

**DOEDERLEIN, DR. THEO. J., Chicago, Illinois**

| No. | Date | Age | Prev. Preg. | Prev. Abort. | Condition and Disposal Opposite Tube | Condition and Disposal Affected Tube | Subsq. Preg. | Subsq. Ect. | Present Condition |
|---|---|---|---|---|---|---|---|---|---|
| 63 | '07 | 25 | 5 | 0 | Removed Subtotal hyster | Removed ectomy. | 0 | 0 | Perfect health |

**FINDLEY, DR. PALMER, Omaha, Nebraska.**

| No. | Date | Age | Prev. Preg. | Prev. abort. | Condition and Disposal Opposite Tube | Condition and Disposal Affected Tube | Subsq. Preg. | Subsq. Ect. | Present Condition |
|---|---|---|---|---|---|---|---|---|---|
| 64 | '08 | 27 | 4 | ? | Healthy; not removed | Ruptured; removed | 1 | 0 | |

**GELLHORN, DR. GEO., St. Louis, Mo.**

| No. | Date | Age | Prev. Preg. | Prev. abort. | Condition and Disposal Opposite Tube | Condition and Disposal Affected Tube | Subsq. Preg. | Subsq. Ect. | Present Condition |
|---|---|---|---|---|---|---|---|---|---|
| 65 | '05 | 26 | ? | ? | Normal; not removed | Unruptured; salpingectomy | 1 | 0 | Diabetes |
| 66 | '05 | 40 | 2 | ? | Normal; not removed | Unruptured; removed with ovary | 0 | 0 | Good |
| 67 | '06 | 24 | 0 | 0 | Occluded; salpingostomy<br>Acu te ap pen dicit is; operated Dec | Ruptured; tube and ovary removed<br>. 16, '09; tube a gain oc cluded ; salpingostomy | 0 | 0 | Good health |
| 68 | '07 | 32 | 0 | 0 | Occluded; salpingostomy | Unruptured; tube and ovary removed | 0 | 0 | Good health |

**GOFFE, DR. J. RIDDLE, New York, N. Y.**

| No. | Date | Age | Prev. Preg. | Prev. abort. | Condition and Disposal Opposite Tube | Condition and Disposal Affected Tube | Subsq. Preg. | Subsq. Ect. | Present Condition |
|---|---|---|---|---|---|---|---|---|---|
| 69 | '03 | 33 | 2 | ? | Normal; not removed | Removed, leaving both ovaries | 1 | 0 | Good |

**GREEN, DR. CHARLES M., Boston, Mass.**

| No. | Date | Age | Prev. Preg. | Prev. abort. | Condition and Disposal Opposite Tube | Condition and Disposal Affected Tube | Subsq. Preg. | Subsq. Ect. | Present Condition |
|---|---|---|---|---|---|---|---|---|---|
| 70 | '00 | 27 | 1 | ? | Not removed | Unruptured; removed | 3 | 0 | Good |

**LOCKHART, DR. F. A., Montreal, Canada**

| No. | Date | Age | Prev. Preg. | Prev. abort. | Condition and Disposal Opposite Tube | Condition and Disposal Affected Tube | Subsq. Preg. | Subsq. Ect. | Present Condition |
|---|---|---|---|---|---|---|---|---|---|
| 71 | '01 | 40 | 2 | ? | Healthy | Ruptured; tube and ovary removed | 0 | 0 | Good |
| 72 | '99 | 36 | 5 | ? | Diseased; removed | Ruptured; tube and ovary removed | 0 | 0 | Good |
| 73 | '01 | 31 | 4 | ? | Healthy | Ruptured; tube only removed | 1 | 0 | Good |
| 74 | '01 | 21 | 1 | 1 | Healthy | Ruptured; tube and ovary removed | 0 | 0 | Good |
| 75 | '02 | 23 | ? | ? | Diseased; removed | Ruptured; tube and ovary removed | 0 | 0 | Good |
| 76 | '05 | 30 | ? | ? | Diseased; removed | Ruptured; tube and ovary removed | 0 | 0 | Good |

**LOCKHART, DR. F. A., Montreal, Canada** (Continued)

| No. | Date | Age | Prev. Preg. | Prev. abort. | Condition and Disposal Opposite Tube | Condition and Disposal Affected Tube | Subsq. Preg. | Subsq. Ect. | Present Condition |
|---|---|---|---|---|---|---|---|---|---|
| 77 | '05 | 23 | 2 | ? | Diseased; removed | Ruptured; tube and ovary removed | 0 | 0 | Good |
| 78 | '06 | 24 | 3 | ? | Chronicly inflamed; removed | Ruptured; removed | 0 | 0 | Good |
| 79 | '06 | 26 | ? | ? | Healthy | Ruptured; removed | 1 | 0 | Good |
| 80 | '06 | 28 | 2 | ? | Hematosalpinx removed | Ruptured; tube and ovary removed | 0 | 0 | Good |
| 81 | '01 | 28 | 0 | 1 | Healthy | Unruptured; removed | 0 | 0 | Good |
| 82 | '04 | 31 | 2 | 1 | Healthy | Aborted; removed | 2 | 0 | Good |
| 83 | '07 | 38 | 6 | 2 | Inflamed Pan-hysterecto | my. | 0 | 0 | Good |

**LYONS, DR. JOHN A., Chicago, Illinois**

| No. | Date | Age | Prev. Preg. | Prev. abort. | Condition and Disposal Opposite Tube | Condition and Disposal Affected Tube | Subsq. Preg. | Subsq. Ect. | Present Condition |
|---|---|---|---|---|---|---|---|---|---|
| 84 | '90 | 22 | ? | ? | Normal; not removed | Ruptured; removed | 0 | 0 | Good |

**McLEAN, DR. MALCOLM, New York, N. Y.**

| No. | Date | Age | Prev. Preg. | Prev. abort. | Condition and Disposal Opposite Tube | Condition and Disposal Affected Tube | Subsq. Preg. | Subsq. Ect. | Present Condition |
|---|---|---|---|---|---|---|---|---|---|
| 85 | '95 | 38 | 4 | ? | Apparently normal | Ruptured; removed | 1 plac. prae full term | 0 | Good health |
| 86 | '98 | 37 | 0 | ? | Apparently normal | Ruptured; removed | 0 | 0 | Good health |
| 87 | '00 | 33 | 2 | ? | Apparently normal | Ruptured; removed | 1 | 0 | Good health |

**MANTON, DR. WALTER P., Detroit, Mich.**

| No. | Date | Age | Prev. Preg. | Prev. abort. | Condition and Disposal Opposite Tube | Condition and Disposal Affected Tube | Subsq. Preg. | Subsq. Ect. | Present Condition |
|---|---|---|---|---|---|---|---|---|---|
| 88 | '03 | 32 | 0 | 0 | Apparently normal; not removed | Ruptured; removed | 0 | 0 | Good |

**MANWARING, DR. J. B., Flint, Mich.**

| No. | Date | Age | Prev. Preg. | Prev. abort. | Condition and Disposal Opposite Tube | Condition and Disposal Affected Tube | Subsq. Preg. | Subsq. Ect. | Present Condition |
|---|---|---|---|---|---|---|---|---|---|
| 89 | '04 | 24 | 1 | 0 | Enlarged and adherent; not removed on account patient's condition | Removed | 0 | 0 | Good |
| | Had | pelv | ic in | flam | mation two mon | ths after operati | on | fro | m rem | aining tube. |

**METCALF, DR. WM. F , Detroit, Mich.**

| No. | Date | Age | Prev. Preg. | Prev. Abort. | Condition and Disposal Opposite Tube | Condition and Disposal Affected Tube | Subsq. Preg. | Subsq. Ect. | Present Condition |
|---|---|---|---|---|---|---|---|---|---|
| 90 | '07 | 36 | 9 | ? | Not removed | Ruptured into broad liga-ment, removed | 0 | 0 | Good |
| 91 | '03 | 26 | 0 | 1 | Abdominal hys | Ruptured tero-salpingo-oo | 0 phrect | 0 omy. | Not known |
| 92 | '04 | 26 | 2 | ? | Adhesions abou tube; abdomin | t ruptured al hysterectomy | 0 | 0 | No data |
| 93 | '03 | 33 | 2 | 1 | Chronic inflammation and kinked | Ruptured; removed | 0 | ,04 | Good |
| 94 | '05 | 30 | 1 | 2 | Adhesions; otherwise normal; not removed | Pregnant in uterine cornu; appendage removed | 0 | 0 | Good or fair |
| 95 | '07 | 41 | 1 | ? | Pelvis filled wit umbilicus; abd erectomy | h pus level to ominal hyst- | 0 | 0 | Good |
| 96 | '06 | 36 | ? | ? | Normal; removed Both ovaries fi | Ruptured; 2½ months' preg. bro-cystic. | 0 | 0 | Good |
| 97 | '06 | 32 | 0 | 0 | Hydrosalpinx; Pelvic adhesion hystero-salping | Ruptured; s; abdominal o-oophrectomy. | 0 | 0 | Good |
| 98 | '05 | | 2 | ? | Adherent; not removed | Ruptured; removed | 1 abort. | 0 | Good |
| 99 | '05 | 26 | 1 | ? | Tube removed; ovary fibro-cystic | Removed ovary fibro-cystic | 0 | 0 | Good |
| 100 | '05 | 30 | ? | ? | Adherent | Ruptured; placenta adherent in cul-de-sac | 0 | 0 | Good |
| | Abd | o mi | nal h | yste | rectomy; double | salpingo-oophre | ctomy. | | |
| 101 | '04 | 39 | 2 | ? | Dermoid cyst Abdominal hys | Ruptured tero-salpingo-oo | 0 phrect | 0 omy. | Good |
| 102 | '03 | 23 | 1 | ? | Apparently normal | Early pregnancy; blood streaming from ampullar portion; removed | 0 | 0 | Good |
| 103 | '03 | 37 | 0 | 1 | Hydrosalpinx; cystic ovary; removed | Tubal pregnancy and mole; removed | 0 | 0 | Good |
| 104 | '06 | 28 | 2 | 1 | Hydrosalpinx; distal end removed | Removed | 0 | 0 | Good |

**MILLER, DR. C. JEFF, New Orleans, La.**

| No. | Date | Age | Prev. Preg. | Prev. Abort. | Condition and Disposal Opposite Tube | Condition and Disposal Affected Tube | Subsq. Preg. | Subsq. Ect. | Present Condition |
|---|---|---|---|---|---|---|---|---|---|
| 105 | '99 | 23 | 1 | 0 | Healthy | Ruptured; removed | 0 | 0 | Good |
| 106 | '06 | 39 | 5 | 1 | Apparently healthy | Ruptured; removed | 0 | 0 | Good |
| | Fift | een pus tom | mon colle s an | ths a ctio d pa | fter operation p n on opposite si ssing period one | atient was opera de freed. This d week. | ted thr evelop | ough t ed afte | he vagina and a r acute symp- |
| 107 | '08 | 34 | 2 | 1 | Apparently healthy | Ruptured; removed | 0 | 0 | Good except dysmenorrhoea |
| 108 | '07 | 37 | 1 | 0 | Apparently healthy but long | Ruptured; removed | 0 | 0 | Good |
| 109 | '07 | 35 | 0 | 0 | Apparently healthy but long | Ruptured; removed | 0 | 6 mos. later | Good |

**MONTGOMERY, DR. E. E., Philadelphia, Pa.**

| No. | Date | Age | Prev. Preg. | Prev. Abort. | Condition and Disposal Opposite Tube | Condition and Disposal Affected Tube | Subsq. Preg. | Subsq. Ect. | Present Condition |
|---|---|---|---|---|---|---|---|---|---|
| 110 | '08 | 33 | 5 | ? | Normal; not removed | Sac formed by tube and ovary both removed | 0 | 0 | Good |
| 111 | '03 | 25 | ? | ? | Not stated | Tube and ovary removed | 2 | 0 | Good |

**NEWELL, DR. FRANKLIN S., Boston, Mass.**

| No. | Date | Age | Prev. Preg. | Prev. Abort. | Condition and Disposal Opposite Tube | Condition and Disposal Affected Tube | Subsq. Preg. | Subsq. Ect. | Present Condition |
|---|---|---|---|---|---|---|---|---|---|
| 112 | '04 | 24 | ? | 1 | Normal; not removed | Removed with ovary | 1 ch. 1 abort. | 0 | At present some pelvic symptoms. mass in left side of pelvis; no operation |
| 113 | '05 | 35 | 6 | ? | Normal; not removed | Ruptured; removed | 0 | 0 | Good |
| 114 | '03 | 31 | 3 | ? | Cond. not stated; ligated; not removed | Cond. not stated; removed by vagina with ovary | 0 | 0 | Good health |
| | Ope | rate | d for | app | endicitis and he | rnia in scar Oct | ober, 1 | 909. | |
| 115 | '05 | 30 | 2 | ? | Not stated; tube resected | Enlarged and ruptured; removed | 0 | 0 | No subsequent operation |
| 116 | '05 | 32 | 2 | ? | Probably left in situ | Removed | 0 | 0 | No subsequent operation |
| 117 | '04 | 33 | 1 | ? | Probably left in situ | Ruptured; removed | 0 | 0 | No subsequent operation |
| 118 | '06 | 28 | 0 | ? | Prolapsed and adherent; left in situ | Adherent but unruptured; removed | 0 | 0 | Good health |

**NEWELL, DR. FRANKLIN S., Boston, Mass.** (Continued)

| No. | Date | Age | Prev. Preg. | Prev. Abort. | Condition and Disposal Opposite Tube | Condition and Disposal Affected Tube | Subsq. Preg. | Subsq. Ect. | Present Condition |
|---|---|---|---|---|---|---|---|---|---|
| 119 | '05 | 36 | 6 | ? | Probably left in situ | Enlarged; bleeding from fimbriated end; removed | 0 | 0 | Health good |
| 120 | '01 | 28 | 2 | 2 | Not stated | Ruptured; removed with ovary | 0 | 0 | Health good |
| 121 | '07 | 38 | 6 | ? | Normal: not removed | Ruptured and bleeding; removed | 1 | 0 | Health good except for post-operative hernia |
| 122 | '05 | 36 | 0 | ? | | Ruptured | 0 | 0 | Good condition |
| | Mul | tiple | fibr | oids | of uterus; uter | us and both tub | es rem | oved. | |
| 123 | '06 | 46 | 4 | ? | Probably left in situ | Pelvic hematocele; drained by vagina | 0 | 0 | No subsequent operation |
| 124 | '02 | 32 | 4 | ? | Normal; left in situ | Removed with ovary | 0 | 0 | Health good |
| 125 | '04 | 35 | ? | 1 | Adherent; left in situ | Ruptured; removed | 0 | 0 | No subsequent operation |
| 126 | '01 | 33 | 2 | ? | Probably left in situ | Buried in organized clot; removed with ovary | 0 | 0 | Health good |
| 127 | '04 | 39 | 2 | ? | Probably left in situ | Pelvic hematocele; drainage from below | 0 | 0 | Health good |

**PETERSON, DR. REUBEN, Ann Arbor, Mich.**

| No. | Date | Age | Prev. Preg. | Prev. Abort. | Condition and Disposal Opposite Tube | Condition and Disposal Affected Tube | Subsq. Preg. | Subsq. Ect. | Present Condition |
|---|---|---|---|---|---|---|---|---|---|
| 128 | '05 | 28 | 2 | 1 | Hematoma of ovary and pus tube; ovary and tube removed | Ruptured; tube and ovary removed | 0 | 0 | Good |
| 129 | '03 | 27 | 0 | 4 | Normal; not removed | Unruptured; removed | 0 | 0 | Menstruated regularly for year and a half; since then periods of amenorrhoea, lasting three or four months during which she has neuritis |
| 130 | '04 | 36 | 1 | 2 | Adherent; tube and ovary removed | Unruptured; tube and ovary removed | 0 | 0 | Good |
| 131 | '04 | 30 | 0 | 1 | Adherent; tube and ovary removed | Ruptured; tube and ovary removed | 0 | 0 | Good |
| 132 | '06 | 24 | 1 | 1 | Vaginal drainage Not lived with | husband since o | p. | | Good health |

**PETERSON, DR. REUBEN, Ann Arbor, Mich.** (Continued)

| No. | Date | Age | Prev. Preg. | Prev. Abort. | Condition and Disposal Opposite Tube | Condition and Disposal Affected Tube | Subsq. Preg. | Subsq. Ect. | Present Condition |
|---|---|---|---|---|---|---|---|---|---|
| 133 | '07 | 30 | 0 | 2 | Adherent; not removed | Unruptured; removed | 0 | 0 | Exopthalmic goitre |
| 134 | '01 Well recently. | 22 | 0 two | ? year | Adherent; adhesions broken up; not removed s; then bladder t | Ruptured; removed rouble; operated | 0 for th | 0 s; stro | Not well ke of paralysis |
| 135 | '02 | 26 | 0 | ? | Adherent; removed | Unruptured; removed | 0 | 0 | Good; suffers some from stomach and nerves |
| 136 | '02 | 27 | sing le | | Adherent; adhesions broken up; not removed | Unruptured; removed | 0 | 0 | Good |
| 137 | '02 | 30 | 0 | ? | Adherent; not removed | Ruptured; removed | 0 | 0 | Good |
| 138 | '02 | 33 | 0 | 3 | Dense adhesions in pelvis Both tubes and | Dilated but not ruptured ovaries remove | 0 d. | 0 | Good but not as strong as before operation |
| 139 | '02 | 33 | 0 | 1 | Normal; not removed | Adherent; removed | 1 | 0 | Good health |

**ROBB, DR. HUNTER, Cleveland, Ohio**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 140 | '00 | 35 | 3 | ? | Adherent to ovary and broad ligt. removed | Ruptured; ligated both ways with silk; stump cauterized | 0 | 0 | Good |
| 141 | '06 | 43 | 4 | ? | Enlarged and adherent; removed | Aborted old ectopic; removed | 0 | 0 | Good |
| 142 | '05 | 35 | 3 | 1 | Adherent to uterus and ovary; removed | Ruptured; removed | 0 | 0 | Good |

**SMITH, DR. RICHARD R., Grand Rapids, Mich.**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 143 | '00 | 22 | | | Vaginal operation | | 0 | 0 | Good |
| 144 | '03 | 36 | 3 | ? | Not recorded | Ruptured on bringing it up; tube and ovary removed | 0 | 0 | Good |
| 145 | '05 | 21 | ? | ? | Normal; not removed | Enlarged; tube removed leaving ovary | 2 ch. 1 ab. | 0 | Good |

**SMITH, DR. RICHARD R., Grand Rapids, Mich.** (Continued)

| No. | Date | Age | Prev. Preg. | Prev. Abort. | Condition and Disposal Opposite Tube | Condition and Disposal Affected Tube | Subsq. Preg. | Subsq. Ect. | Present Condition |
|---|---|---|---|---|---|---|---|---|---|
| 146 | '06 | 31 | 1 | ? | Old clots around appendage otherwise normal; not removed | Right appendage included in mass tube and ovary removed | 0 | Yes | Good |
| 147 | '05 | 31 | 0 | ? | Normal; not removed | Ruptured; removed, leaving ovary | 0 | '11 | Some pelvic trouble twice otherwise well |
| 148 | '06 | 32 | ? | ? | Slight thickening at end: small cyst of ovary; tube and ovary left intact | Large mass in extreme end: showed point of rupture; tube and ovary removed | 0 | 0 | Good |
| 149 | '07 | 32 | 1 | ? | Normal; not removed | Contained large mass; tube removed | 0 | 0 | Good |

**STEVENS, DR. EDMUND H., North Cambridge, Mass.**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 150 | '89 | 23 | 0 | 0 | Normal; not removed | Ruptured; tube and ovary removed | 3 | 0 | Good |
| 151 | '90 | 36 | 1 | ? | Normal; not removed | Ruptured; removed | 1 | 0 | Good |
| 152 | '91 | 33 | Not Married until three years after | | Normal; not removed | Ruptured; removed | 0 | '92 | Good |
| 153 | '91 | 23 | 0 | 0 | Bound down by adhesions from pelvic peritonitis | Ruptured; removed | 0 | '92 | Good |
| 154 | '92 | 30 | 2 | ? | Normal; not removed | Ruptured; removed | 0 | 0 | Good |
| 155 | '92 | 36 | 4 | ? | Normal; not removed | Ruptured; removed | 1 | 0 | Good |
| 156 | '96 | 37 | 1 | ? | Cystic; removed | Ruptured; removed | 0 | 0 | Good |
| 157 | '96 | 39 | 3 | ? | Normal; not removed | Ruptured; removed | 0 | 0 | Good |
| 158 | '96 | 22 | 0 | ? | Apparently normal; not removed | Ruptured; removed | 0 | '98 | Not good; nervous |
| 159 | '97 | 38 | ? | ? | Had been removed two years before | Ruptured; removed | 0 | 0 | Good |
| 160 | '97 | 29 | ? | ? | Adherent to ovary; not removed | Ruptured; removed | 0 | 0 | Good |

**STEVENS, DR. EDMUND H., North Cambridge, Mass.** (Continued)

| No. | Date | Age | Prev. Preg. | Prev. Abort. | Condition and Disposal Opposite Tube | Condition and Disposal Affected Tube | Subsq. Preg. | Subsq. Ect. | Present Condition |
|---|---|---|---|---|---|---|---|---|---|
| 161 | '98 | 36 | 4 | ? | Apparently normal; not removed | Ruptured; removed | 2 | 0 | Good |
| 162 | '98 | 39 | 1 | ? | Apparently normal | Ruptured; removed | 0 | 0 | Good health until death in 1909 |
| 163 | '00 | 34 | 1 | ? | Doubled on itself; cyste removed | Ruptured; removed | 0 | 0 | Poor health |
| 164 | '00 | 24 | 0 | 1 | Adherent to appendix: filled with pus removed | Ruptured; removed | 0 | 0 | Good Health |
| 165 | '01 | 31 | ? | ? | Normal in appearance | Ruptured: removed | 0 | '03 | Good |
| 166 | '01 | 36 | 1 | ? | Normal in appearance | Ruptured; removed | 2 | 0 | Good |
| 167 | '03 | 32 | 1 | ? | Normal in appearance | Ruptured during office examination | 4 abort. | 0 | Good |
| 168 | '04 | 22 | Un-mar ried | | Normal in appearance | Eroded; ovum and clot in tube; tube split and clot removed | 0 | 0 | Good |
| 169 | '06 | 28 | 1 | ? | Normal in appearance | Ruptured; removed | 1 abort. | 0 | Good |
| 170 | '08 | 33 | 0 | ? | Normal in appearance | Ruptured; removed | 0 | 0 | Good |

**STONE, DR. ISAAC S., Washington, D. C.**

| No. | Date | Age | Prev. Preg. | Prev. Abort. | Condition and Disposal Opposite Tube | Condition and Disposal Affected Tube | Subsq. Preg. | Subsq. Ect. | Present Condition |
|---|---|---|---|---|---|---|---|---|---|
| 171 | '99 | 34 | 0 | ? | Not removed | Ruptured; tube and ovary removed | 2 | '07 | Good |
| 172 | '98 | 25 | 1 | ? | Good; not removed | Ruptured; removed | 0 | 0 | Good |
| 173 | '00 | | 0 | ? | Good; not removed | Ruptured; removed | 0 | 0 | Good |
| 174 | '97 | | 1 | ? | Not removed | Ruptured; removed | 0 | 0 | Good |
| 175 | '93 | 28 | 0 | 0 | Thickened; not removed | Removed | 0 | 0 | Good |

**TAUSSIG, DR. FREDERICK J., St. Louis, Mo.**

| No. | Date | Age | Prev. Preg. | Prev. Abort. | Condition and Disposal Opposite Tube | Condition and Disposal Affected Tube | Subsq. Preg. | Subsq. Ect. | Present Condition |
|---|---|---|---|---|---|---|---|---|---|
| 176 | '06 Sub | 27 sequ still | 3 enta felt | ? ttac | Apparently healthy k of salpingitis; | Ruptured; removed mass size of lem | 0 on; we | 0 ll in fo | Good ur weeks; mass |

**VINEBERG, DR. HIRAM N., New York, N. Y.**

| No. | Date | Age | Prev. Preg. | Prev. Abort. | Condition and Disposal Opposite Tube | Condition and Disposal Affected Tube | Subsq. Preg. | Subsq. Ect. | Present Condition |
|---|---|---|---|---|---|---|---|---|---|
| 177 | '99 | 29 | 4 | 2 | Normal | Not stated; removed | 0 | '02 | Good |
| 178 | '02 | 30 | 0 | ? | Normal; not removed | Ruptured; matted with ovary and broad lig't | 0 | '07 | Good |
| 179 | '02 | 28 | 1 | ? | Normal; not removed | Ruptured; removed | 0 | '10 | Not known |
| 180 | '03 | 40 | Last chd 14 yrs. ago | ? | Not noted on account patient's condition Associated wit | Ruptured; foetus placenta and tube in blood tumor in cul-de-sac; tube removed h uterine pregna ncy. | 0 | 0 | Good |
| 181 | '04 | 30 | 1 | ? | Covered with omentum; apparently normal; not removed | Dilated to size of orange; removed | 1 | 0 | Good |
| 182 | '07 | 28 | 1 | ? | Normal | Enlarged and congested; removed with ovary | 1 | 0 | Good |
| 183 | '03 | 25 | 1 | ? | Not stated | Not stated; removed | 0 | '08 | Good |
| 184 | '05 | 28 | 0 | 0 | Normal | Blood clot dilating tube entire length; adherent to broad ligament posteriorly; ligated near uterus; removed leaving ovary | 2 ab. due to incess-ant emesis | 0 | Good |
| 185 | '04 Ass | 28 ocia | 0 ted | 0 with | Normal uterine pregna | Enlarged and ruptured; removed ncy, going on to | 1 term. | 0 | Good |
| 186 | '04 | 40 | Last 7 yrs. ago | ? | Normal; left intact | Ruptured; placenta and tissue adherent to fimbriated end; tube removed | 0 | 0 | Good |

WATKINS, DR. THOMAS J., Chicago, Ill. (Continued)

| No. | Date | Age | Prev. Preg. | Prev. Abort. | Condition and Disposal Opposite Tube | Condition and Disposal Affected Tube | Subsq. Preg. | Subsq. Ect. | Present Condition |
|---|---|---|---|---|---|---|---|---|---|
| 187 | '04 | 33 | 0 | ? | Pyosalpinx; excised | Ruptured; excised | 0 | 0 | Good |
| 188 | '05 | 33 | 2 | 2 | Normal; not removed | Ruptured; excised | 0 | Yes | Good |
| 189 | '05 | 35 | ? | 1 | Absent* | Ruptured; excised | 0 | 0 | Good |
| | *Patient operated soon after marriage for double abortion | | | | | | tubal occlusion following | | |
| 190 | '05 | 34 | ? | ? | Normal; not removed | Ruptured; removed | 0 | 0 | Good |
| 191 | '07 | 29 | 0 | ? | Normal; not removed | Ruptured; removed | 0 | 0 | Good |
| 192 | '07 | 33 | 2 | ? | Old salpingitis; excised | Ruptured; excised | 0 | 0 | Good |

surgeon and the interest he has in learning the truth. The entire list of cases reported by each man will be published with this paper.

Let us first dispose of the matter of morbidity subsequent to operation. In the 188 cases in which reports are made as to the present health (four cases health not stated but other details given), it is described as "excellent," "good," or "fair," in 145 instances. All who have had anything happen that was worthy of note, even though their present condition of health be satisfactory, have been excluded from this number. These terms must, of course, be accepted in their ordinary sense and would vary somewhat in meaning, according to the understanding of the reporter as to what was meant by the question. As stated, these women have had nothing of note occur (normal pregnancies excepted) and are well in the ordinary meaning of the term.

Six patients are suffering from ailments of a more or less serious character, not traceable to the ectopic pregnancy or operation, including one patient with exopthalmic goiter (Peterson) six years after operation, and one (Gellhorn) with diabetes eight years after operation.

Besides these, the following deserve special mention:

One patient had operation for appendicitis three years afterwards, and an occluded "opposite" tube, upon which a salpingostomy had been done at the original operation, was found again closed and was reopened. No pregnancies since operation seven years ago. (Gellhorn.)

One had operation six years later for acute appendicitis and for a hernia in the scar. Health now good. (Newell.)

One has ventral hernia — not operated. (Newell.)

One had ventral hernia repaired — health now good. (Currier.)

One had operation on the bladder — details not given; not well since; a stroke of paralysis lately. (Peterson.)

One had operation for "cystic condition of the ovary and salpingitis"— right adnexa removed. (Ballin.)

One had indefinite pelvic symptoms (two ectopics; no children)—no examination. (Smith.)

Three have at present induration or masses in the pelvis and more or less pelvic symptoms, but no operation advised. (Anspach, Newell and Taussig.)

One had pelvic inflammatory condition from remaining tube. (Manwarring.)

One has uterine prolapse. (Brettauer.)

One has fibroid, now inflamed, following recent childbirth — three children since ectopic. (Brettauer.)

One had ileus following operation; operated four years later — removal of remaining tube and repair of ventral hernia. (Barrett.)

One in which there was a question as to whether patient did or did not have a repeated ectopic fifteen months after the first operation. Patient was operated per vaginam and a pus collection on the opposite side evacuated. This had developed after acute symptoms and one week after a missed period. (Miller.)

One died eleven years after operation of unknown cause — health until then good. (Stevens.)

Those who had a second ectopic will be discussed later. No effort was made to obtain the immediate mortality from operation and where such reports were sent me they were excluded from the list.

The final results from operation, excluding the cases of repetition to be mentioned, were, it appears, very satisfactory. But very fev of these patients have suffered any serious inconvenience in subsequent years from their ectopic pregnancy or operation, and a large number doubtless owe their lives to the intervention.

As suggested at the beginning of this paper, there are two things in the future course of these patients which interest us most of all, more so since we commonly have them directly within our control at the time of operation — one the question of further normal pregnancy and the other that of repetition of a tubal one. If the opposite tube is hopelessly closed and the condition of our patient permits, the general rule is to remove it (and perhaps other diseased organs), and few would seriously question this procedure. A very large percentage of our ectopic cases remain sterile following operation (in this list, 97 out of 144 in which pregnancy might conceivably occur). How much the repair processes that follow the extravasation of often large quantities of blood, especially when long retained, may have to do with this is a question. As a rule, however, these conditions are much less persistent than follow a pelvic infection involving the same structures. Even after most extensive extravasations, pregnancy not infrequently takes place, so that we may well afford to deal conservatively with the remaining tube if further pregnancy is desirable and the tube itself in good condition. It is usually considered advisable to gently separate the adhesions about these tubes when such are present. Engström has done this in six cases resulting in normal pregnancy, and Prochownik has seen the same results four times in his series.

Although salpingostomy and other plastic operations have not yielded very encouraging results, they might perhaps be tried.

But what if we leave a normal, patulous tube, or one that we are capable of releasing and perhaps making so? Knowing that the same accident may occur in such a tube that is left, our only reason for leaving it, the patient's condition permitting, is that it will make possible a normal uterine pregnancy. What does the future of this class show in our series of cases? There are here 192 cases traced for a period of five years or more. Of these, forty-eight had operations of a nature to preclude further pregnancies, or had already had the other tube removed.

12 had hysterectomies.
31 opposite tube removed.
3 opposite tube had previously been removed.
1 distal end removed for hydrosalpinx, making pregnancy very improbable.
1 tube ligated but not removed.

In this list no opposite tubes were, according to our records, removed except for disease. These cases must, of course, be completely excluded from consideration in estimating further pregnancies. There is no justification for including them.[1]

[1] In those cases in which the record of the condition and disposal of the opposite tube was not complete, we have assumed that it was retained and, therefore, that pregnancy was possible. Eight of these were vaginal sections.

The inquiry into the civil condition of the patient after operation would seem to indicate that this factor in the occurrence of subsequent pregnancy should not be taken seriously into account.

This leaves 144 in which a pregnancy was conceivably possible. Forty-seven of these women have had uterine pregnancies, or 32.6+ per cent (forty-two with living children, sixty-four children in all; one stillborn, five aborting without children, five had abortions and children), ninety-seven had none. There were twenty-one cases of repeated ectopic pregnancy, half as many as had living children. Two women had subsequent children and a repeated ectopic. Of the sixty-seven women under thirty years of age, twenty-seven had subsequent uterine pregnancies, ten had a repeated ectopic pregnancy. Of the seventy-four women above thirty, nineteen had subsequent uterine pregnancy, and eleven had a repeated ectopic. In three cases age (not given, but tube retained), one of these had a subsequent pregnancy.

If, then, much less than half of our ectopic cases have children subsequently (Essen-Möller 46 per cent, Prochownik 43.8 per cent, our figures 32.6 per cent), and 14.6 per cent repeat their ectopic, leaving out the few women who have had further inflammatory trouble with the opposite tube, is it best to always save the opposite tube when it seems capable of transmitting the ovum? Each man must answer this question for himself, according to his convictions on the matter of preserving the childbearing function and the seriousness that he attaches to a further ectopic pregnancy. He will, according to his habit, defer little or much to the wishes of the patient in the matter; but whatever his action, it should be determined after serious consideration of these facts. In young women the desirability of preserving the childbearing function is of greatest importance. In time and with the advent of children, this desirability ordinarily diminishes. In the beginning it overrules all but the most serious considerations and would lead us always to conservation; later other less serious considerations (mainly the possibility of a second ectopic pregnancy) must be taken into account.

In other pelvic lesions we ordinarily maintain a most conservative attitude in our younger patients — later we do not hesitate to remove the possibility of children if the preservation of the necessary organs threatens to implicate her health. Why should we not do the same with our ectopic cases? Would we not best serve her interests by removing the possibility of a repetition of this distressing accident when the need of children is no longer so urgent? With these patients, as with all others in whom an operation which may involve the childbearing function is considered, I believe we should discuss the matter freely with her and be governed to a certain though limited extent by her wishes. Not the favorable appearance of a tube, but the future history of such recorded cases should be the basis for our judgment. Her age, the number of children she has borne, her general health and her wishes as to further pregnancies should all enter into this consideration. If she then has another tubal pregnancy, we shall at least have a good excuse for having deliberately submitted her to its serious possibilities. Personally, I am now removing the opposite tube in those women in whom, for reasons suggested above, childbearing is no longer desirable — in others I preserve it.

# EXCISION OF THE CLAVICLE AND FIRST RIB FOR MALIGNANT DISEASE

By R. E. FORT, M D., Nashville, Tennessee

MUCH doubt exists as to whom credit should be given for the honor of first completely excising the clavicle. Treves (1) gives McCreary of Kentucky priority, 1811. Gross (2) credits Remmer as the first operator in 1732. Zabel (3) credits Moreau and D'Angerville of Paris with the first total excision in 1765, and claims that the operation of Remmer was without doubt, a partial, not a total, extirpation. Heyfelder (4) gives Meyer the credit of the first in 1823, and Cassebohn with the first partial extirpation in 1719, and Coley (5) credits Valentine Mott with the first in 1828.

Without attempting to harmonize this conflict of authorities as to who is entitled to this honor, we were astonished to find reports of only sixty-four total excisions, one of excision of the clavicle and sternal ends of the first and second ribs, "Morfitt's Case" reported by Carson (6) and no reported cases of total excision of the clavicle and the first rib.

It is the writer's object to report a case of excision of the clavicle and first rib, but it will not be amiss to notice some of the important facts concerned in the literature of excision of the clavicle. Mott in his report says, "This operation far surpasses in tediousness, difficulty, and danger anything that I have ever witnessed or performed. It is impossible for any description which we are capable of giving to convey an accurate idea of its formidable nature." Velpeau (7) calls the operation "a daring attempt never carried into effect except in a few cases of operation upon the shoulder," yet he says, "There are circumstances sufficiently numerous which require this operation if we wish not to abandon the sufferers to certain death." C. Norkes (8) collected thirty-two cases of excision for malignant tumors, of which twenty-four were sarcoma, five reported as carcinoma, two exarthrosis, and one chondroma, with six deaths. Coley states that the cases reported as carcinoma were probably sarcoma, as primary carcinoma of the clavicle is unknown.

Since 1893, Coley has collected thirty-two additional cases, making a total of sixty-four.

The immediate mortality of excision of the clavicle is between sixteen and eighteen per cent, but the end-results, or those who die from recurrence, is quite seventy per cent. The results, however, are sufficiently hopeful to make immediate surgical intervention not only justifiable but mandatory.

The types of tumors observed by pathologists have been varied,—periosteal, round-cell; periosteal, spindle-cell; osteosarcoma, small round-cell, spindle-cell; myeloid, round-cell; myelogenous, chondroma; embryonic, myeloid; myeloid fibrous and fibro-plastic, and my own osteosarcoma, giant-cell.

*Ages of patients.* Two between one and ten years, twenty between ten and twenty, nine between twenty and thirty, twelve between thirty and forty, seven between forty and fifty, one between fifty and sixty, and three between sixty and seventy.

*Diagnosis.* A study of the reported cases makes it quite clear that the diagnosis must be made early if there is to be a probability of saving the patient. No variety of tumor is more malignant than a majority of sarcomata of the clavicle. The vascularity of the neck insures early infiltration and rapid generalization. The history of antecedent trauma is important. Seven of the nine cases observed by Coley gave histories of trauma. In most cases the swelling will be noted very soon after the receipt of the injury. In its early stages, it is usually hard, smooth, and immovable.

*Tuberculosis.* Tuberculosis is a condition from which sarcoma must be differentiated. "A history of tuberculosis in the family, or tuberculosis in some other portion of the body, would justify us in ruling out sarcoma" (Coley). It is also to be noted that primary tuberculosis of the clavicle is extremely rare.

and sarcoma is prone to occur in strong and healthy individuals, and more often in the young than in the middle-aged and old.

*Syphilis.* This is a rare condition in the clavicle, so where no other bone is involved, where the clinical diagnosis is reasonably indicative of sarcoma, especially where the tumor has appeared in a young person showing rapid growth, excision should be done without excising a portion of the tumor for microscopical examination, thereby giving the opportunity for localized infection. It is usually impossible to make a satisfactory frozen section for the reason that decalcification must first be made. We would advise total extirpation, as partial extirpation of any bone for sarcoma is incomplete surgery. Coley, Richardson, and others advise treatment with the mixed toxins of erysipelas and bacillus prodigiosus as a prophylactic against recurrence. Coley claims that it is entirely free from danger, and this has been my observation, but frankness compels me to state that my results from its use in sarcoma in other bones have been disappointing. Bearing in mind, however, the statements of Coley that it is without danger, and that in cases of sarcoma of the long bones generally in which toxins have been used, recurrences have been less than one-third as frequent as in cases in which they have not been used, justification for its use in all cases would seem apparent.

*Results after excision.* In two cases there was recurrence in four years after operation, in two within eighteen months, in one case sarcoma of the femur developed three months after operation, in one case there was local recurrence within six months, in one recurrence was immediate, in one sarcoma recurred in the upper jaw nine months after operation, in three cases recurrence was within three months, in seven recurrence occurred within six months, two were well five years after operation, one case well one year, one case well seven months, one case fifty years, and the case reported below well six months after operation.

A. B., age eleven years, mother living, father died by violence; no family history of tuberculosis or syphilis. Patient a fairly well developed boy, no Hutchinson's teeth or other evidence of congenital syphilis. Tumor of clavicle was noticed eight months before he presented himself. At five months he was seen by another surgeon who cut down on the tumor, chiseled it away as best he could, and submitted the specimen to Dr. Wm. Litterer who reported giant-cell osteosarcoma. The wound healed, but the tumor rapidly reproduced itself, and when he presented himself to us July 23, 1913, a tumor the size of an English walnut was attached to the inner third of the clavicle and first rib. It was hard, smooth, and firmly attached at its base, with no history of trauma.

The diagnosis of malignancy having already been made, we advised its immediate removal. A T-shaped incision was made, from the sternum along the lower border of the clavicle, to the coracoid process of the scapula, and from the upper portion of the sternum to the upper border of the second rib. The skin over the tumor was removed by an elliptical incision, and realizing the danger of division of the clavicle, disarticulation was made from the sternum and first rib, the cervical fascia and sterno-mastoid muscle incised well above the tumor until the middle portion of the clavicle was reached; here the trapezius muscle was separated from its clavicular attachments close to the bone. The same method was used below. The clavicle was lifted from its sternal end and separated from the mediastinum, the pleura, the subclavian vessels and ligaments by gauze and scissor dissection. The rib was not disarticulated from the sternum, separating it from the scalenus medius and intercostal muscles, the mediastinum and the pleura by blunt dissection; the close proximity of the subclavian vessels passing through the subclavian grooves of the first rib was the most tedious part of the procedure. A small abdominal retractor was padded with gauze and the vessels held up by an assistant during the removal of the outer part of the rib. The dissection completed to its vertebral attachment, some difficulty was encountered in disarticulation; finally this was accomplished by inserting blunt scissors into the articulation and severing the ligament. The tumor was sufficiently close to the sternum for me to indulge in the fear that this bone had become affected. Consequently we removed about one-half of the sternum from its upper portion to upper portion of the second rib. The safety of this procedure was, I think, guaranteed by the separation of the mediastinum from the posterior surface of the sternum and its protection with gauze. I can conceive no more important step of this operation than the protection of the pleura and mediastinum from wound, as a large percentage of immediate fatalities have been caused by infection of these cavities. The wound was closed by approximating the cervical fascia, the sternomastoid and the trapezius muscles above, and the deltoid and fibers of the pectoralis major muscles below. The skin was closed and approximation of the internal half of skin secured by a flap from below.

A cigarette drain was inserted at the middle portion of the wound; no vessel was tied throughout the operation. Time of operation, one hour and forty-five minutes. There was no injury to either the mediastinum or the pleura, consequently there was no infection.

The patient sat up on the fourth day, and made an uninterrupted recovery, leaving the hospital on August 18th, having gained ten pounds in weight. After ten days the use of the left arm was encouraged. The two features which impressed us most were the free use of the arm, and the absence of deformity of the left chest. In the absence of the scar it would be hard to detect the side upon which the excisions had been done. Toxins of erysipelas and bacillus prodigiosus were given in increasing doses until the dose was established, and this dose was persisted in for two months after operation.

A letter received from his uncle, Dr. J. D. Bryant of Fayetteville, Tennessee, dated December 3d, reports that he is going to school, growing, and has no evidence of recurrence. He also reports that he shucks corn, harnesses the horses, hauls wood with his goat and wagon; in fact, he can see no deficiency in the left shoulder.

## CONCLUSIONS

First, primary sarcoma of the clavicle is a rare condition, and the earlier the diagnosis and the more radical the treatment, the better the chances for complete recovery.

Second, the writer is of the opinion that partial excision of the clavicle or first rib should not be practiced for malignant disease.

Third, the danger of local or general metastases is very great, and as division of the bone increases this hazard, excision should be made with the bone intact.

Fourth, because of the favorable results obtained in the few cases of sarcomata of the clavicle and the larger number of sarcomata of the long bones, it is advisable to use the mixed toxins of erysipelas and bacillus prodigiosus for two or three months after operation.

Fifth, under modern aseptic conditions the mortality for excision of the clavicle and excision of the first rib should be comparatively small, and, considering the fate of the patients who are denied surgery, the opportunity of relief by surgery is mandatory.

## BIBLIOGRAPHY

1. Operative Surgery, p. 638.
2. System of Surgery, ii, p. 1077.
3. Zur Casuistik der Total Extirpation der Clavicle.
4. Lehrbuch der Resection, 1863, p. 300.
5. Tr. Am. Surg. Ass., 1910, xxviii, 3390.
6. Tr. Am. Surg. Ass., 1904, xii, 252.
7. Rouse London, March 23, 1889, i, 575.
8. Beitr. z. klin. Chir., 1893, xi, 729.

# ORIGINAL SURGICAL USES OF THE BONE-GRAFT[1]

## A Report of Two Hundred and Fifty Cases

By FRED H. ALBEE, A. B., M. D., F. A. C. S., New York City
Professor and Adjunct Professor of Orthopedic Surgery at the University of Vermont and New York Post-Graduate Medical Schools

THIS report of original surgical uses of the bone-graft is a supplement to the following communications which appeared in the Folder of the American Orthopedic Association, May 15, 1911; Journal of the American Medical Association September 9, 1911, and August 3, 1912, p. 353; The Post-Graduate, November, 1912, xxvii, No. 11; Author's Stereo-Clinic, published by Southworth Co.; American Journal of Surgery, January, 1914, and Zeitschrift f. Orthopädische Chirurgie, xxxi.

This paper is based upon an experience gained from 253 human bone-graft cases over a period of three years, also a large amount of animal experimentation devoted to the study, both macroscopic and microscopic, of the bone-graft when used in ways similar to the technique employed in the human cases.

The following technique of applications of the bone-graft involves the author's original usage, so far as the writer is informed, with the exception of three incidences.

These cases have been operated in the past three years, and include 178 cases of Pott's disease, sixteen wedge-graft corrections in case of congenital club-foot, seventeen inlay grafts for ununited fractures of the long bones, fourteen cases of paralytic foot deformities; the remaining twenty-eight cases include bone-graftings for fixation of tubercular ankle, repair of osteomyelitic cavities, transplanting astragalus for absent head and neck of femur, the correction of paralytic drop-wrist, deformity of the tibia following fracture, underdevelopment of the jaw, fixation of tubercular knee, reënforcing the bony deficiency and muscular weakness in spina bifida, in conjunction with arthroplasty for paralytic dislocation of the hip, congenital dislocation of the hip, paralytic scoliosis, restoring depressed nasal bridge, fixation of tubercular sacro-iliac joint, ununited fracture of the spine, ununited fracture of the femoral neck, congenital absence of tibia, replacing bone deficiency following removal of osteosarcoma, mobilizing ankylosed hips and carpus by the use of osteocartilaginous grafts.

Enough time has not elapsed in some of the later cases to be able to draw trustworthy conclusions as to their ultimate results. But as our early cases have proved the permanency of the graft and result up to three years, and as other observers have followed bone-graft cases even as long as thirty years, we believe that the reliability and permanency of the bone-graft has been sufficiently proven.

We agree, also, with McWilliams that the periosteum on the graft plays an important rôle in aiding to establish a more abundant and earlier blood supply or nutrition to the graft, as I have previously stated.[2]

The endosteum and the marrow substance also serve a similar purpose to the periosteum, either acting as a ready medium through which the bone transplant gets its nutrition, or, in case the bone-cells in the graft die, furnishing living active cells through which the graft is regenerated

The membranes covering cortical bone act largely as the physiological media through which these cortical cells naturally get their nutrition; again, their loose structure is very favorable to taking up nourishment or establishing vascular means to that end with the environment in which they are placed. Therefore, the wisdom of including these structures on all grafts is obvious. Attention should also be called to the fact that the bone-graft stimulates an active osteogenesis on the part of the recipient bone itself, therefore contributing further in this way toward the assurance of permanency of result.

The execution of the technique involved in the application of the bone-graft in many

[2] J. Am. M. Ass., 1913, April 5th.

[1] Read before the Congress of German Surgeons, April 14th, 1914, Berlin, Germany.

of the conditions enumerated above would be difficult, slow and inexact, except for the adaptation of the electric motor and the author's attachments, such as special twin saws, drills, burrs and doweling instrument. These save time, avoid traumatism both to bone and soft tissue, favor precision in molding the graft and preparing its bed, simplify and make easier the technique in deep wounds and regions difficult to get at with hand tools (Fig. 1).

A rapidly revolving motor instrument, according to Crile's kenetic theory, should diminish shock on account of the lessened excitation of the afferent nerves from a rapidly moving instrument and consequently the minimum resultant disturbance to the nerve centers.

From clinical observation it is apparent that whatever shock occurred when hand bone-cutting instruments were used has largely, if not entirely, disappeared since the development and use of the motor instrument. Whether this is due to the marked shortening of the time of operation or to Crile's theory or to both, and in what proportion, it is very difficult to demonstrate.

The impossibility of obtaining actual immobilization of diseased vertebræ in Pott's disease by any external means, whether by spinal brace, plaster of Paris jackets or recumbency, was the chief stimulus which caused the author to resort to the bone-transplant as the simplest and most trustworthy means of actually immobilizing the diseased vertebræ.

Additional advantages of internal fixation by the bone-graft are obvious, such as the correction of the kyphosis in suitable cases, and the prevention of progression of deformity by controlling the leverage action of the involved vertebræ. It accomplishes this by its splint action and by preventing the separation of the posterior ends of the lever which are the spinous processes. This prevents the approximation or crushing together of the anterior arms of the levers which are the bodies. This is most important, as crushing of the vertebral bodies due to superincumbent weight, muscular spasm and respiratory action is a most important factor in causing the prolongation of the convalescence of Pott's disease.

It is also believed that internal bony immobilization of a tubercular joint, in conjunction with a proper régime of life for tuberculous patients, is the most ideal treatment. This is immediately obtained by use of the bone-graft as herein described (Fig. 2).

Calve and Lelievre[1] confirm Minard's statement that osseous tissue affected by tuberculosis is never restored from the diseased parts, and that if partially destroyed vertebral bodies are held apart for a long time by plaster of Paris jackets or other external support, they will come in contact again and the kyphosis will recur when these supports are removed. This is an additional convincing reason for the use of the bone-graft in producing a bony union by implanting it into the uninvolved posterior segment of the vertebræ with the kyphosis corrected and the diseased vertebral bodies separated.

The perfected technique of the author's operation for Pott's disease, ununited fractures of the spine, etc, is as follows (Fig. 3). With the patient in the ventral position, the tips of the spinous processes are reached by a curved incision and turning up of a flap of skin and subcutaneous tissues. With a scalpel the periosteal tips of the spinous processes are split in the center, also the supraspinous ligament. The interspinous ligaments are next split into approximately equal parts, to a depth of about one-half inch (12.70 mm.), varying with the age and the size of the patient, without disturbing their attachments to the spinous process. Very little hæmorrhage results, because only dense ligamentous tissues are incised, which is in considerable contrast to the hæmorrhage resulting from the separation of the muscles from the spinous processes in a deeper operation, such as a laminectomy, etc. With a thin sharp chisel or author's osteotome and mallet each process is split longitudinally into equal parts for a depth of about one-half inch (12.70 mm.), care being taken that greenstick fractures are produced on one and the same side of all the spinous processes so split. The unbroken halves

[1] Am. J. Orthop. Surg., 1913, Oct.

preserve intact the leverage of these processes. A separation of the halves of each spinous process produces a gutter into which the transplant is later placed. In all cases the full thickness of the tibial cortex is included with the periosteum, endosteum and attached marrow substance, thus producing a transplant with approximately a rectangular cross-section.

It has been found advisable for bone-grafts for all purposes to include periosteum and endosteum, as it is through these media that cortical bone largely receives its nourishment. Thus the graft approximates a complete organic structure, with its normal means of distributing nourishment, and the early establishment of blood supply is enhanced.

A graft of this thickness necessitates producing a full fracture of one half of the spinous process and setting it over laterally in order to place it deep enough to be well covered with the above-mentioned ligaments. It is important that the spinous processes be split *in situ* with all the ligamentous and muscular insertion undisturbed as in this way none of the natural supports of the spine are taken away and the ligaments afford, by means of strong ligatures, an excellent medium for firmly fixing the bone-splint in place.

The depth to which the spinous processes are split varies as to age, size of patient, and amount of pressure atrophy from former apparatus, etc., which may so reduce the spinous processes as to present mere tubercles on the posterior aspect of the neural arches and in certain instances can be split in depth only three-sixteenths to one-fourth of an inch (4.75 to 6.35 mm.), but this affords good bone contact, and as the graft is embedded into longer spinous processes at either end, it affords the usual efficient fixation. A hot saline pack is placed over the back wound until the bone insert is obtained.

With the patient still in the ventral position, the leg is flexed on the thigh and an incision over and down to the crest of the tibia is made. The fascia and subcutaneous tissues are carefully separated from the periosteum of the anterior-internal flat surface of the tibia. From its crest and anterior-internal aspect a strip of the tibia is removed with a motor saw. A motor saw affords a very rapid and exact method of securing the graft and is used exclusively for this purpose. The length of graft varies according to how many vertebræ are to be spanned, *i. e.*, all those diseased and two healthy ones on each side, if in the dorsal region, and one on each side if in the lumbar region, its breadth from one-fourth to five-eighths inch (6.35 to 15.85 mm.), its thickness from three-sixteenths to three-eighths inch (4.75 to 15.51 mm.), according to the size of the patient. The graft is inserted between the halves of the interspinous ligaments and the spinous processes with its edge anterior or innermost, and its cut side or marrow side in contact with the unbroken halves of the spinous processes. It is held firmly in position by interrupted sutures of heavy or medium kangaroo tendon, which are passed through the supraspinous ligament and posterior edges of the halves of the interspinous ligaments near the tips of the spinous processes, beginning at the center of the graft. The ligaments are then drawn over the insert posteriorly by tense sutures placed closely together. Before tying the last sutures the posterior corners of the ends of the graft are removed by the rongeur forceps, and these fragments of bone, with others, are cut into small pieces and placed under and about each end of the graft; the ends of the graft are then drawn down and sutures tied. This is important as it furnishes multiple foci for a rapid proliferation of bone, as, according to Macewen, the smaller the graft the greater the relative bone growth. If there is a moderate kyphosis of short duration, it is entirely obliterated; any kyphosis of a few years or less duration becomes much diminished, either at the time of operation or during the first few days after, from the corrective effect of the lateral tension of the graft.

This sequence of the technique is important because, by preparing the back wound first and packing it with a hot saline compress, we secure hæmostasis, and control the blood-clot about the graft, a condition to be desired.

A certain amount of blood-clot is desired as it facilitates bone growth. The serous ooze which takes place from the several tissues furnishes a good culture medium for the bone-graft. This medium, blood, serum or plasma, has been sought in preparing tissue cultures for the microscopical study of cellular bone-growth. Cold abscesses about the spinous processes are rare, but when found do not usually interfere with satisfactory union. Where a kyphos is too great for implanting a straight splint properly in place in the spinous processes, the approximate contour of the knuckle is obtained by bending a silver probe over the tips of the spinous processes. The curved probe is then laid upon the anterior-internal aspect of the tibia as a pattern, and a graft of the desired shape, width and thickness is outlined in the periosteum with a scalpel. The graft, however, is always straighter than the kyphosis and the spine is straightened by usual pressure and drawn to the bone-splint by means of the heavy ligatures. When the deformity is too great, even for this method, the graft is placed with its wider diameter in a lateral rather than anterior-posterior plane, and then bent into place between the halves of the spinous processes and held with heavy kangaroo tendon, as above indicated.

This bending is accomplished by making numerous saw-cuts one-half to two-thirds the way through. These cuts not only shape the graft to the kyphos, but also favor a rapid establishment of blood supply and the throwing out of bone callus from the graft itself. The cross cuts, one-eighth to three-eighths inches (3.17 to 9.51 mm.) from each other, are always made on the marrow side. The transplants vary in size from four to seven and one-half inches (10.16 cm. to 19.05 cm.) in length, one-fourth to one-half (6.35 to 12.70 mm.) in width, one-fourth to three-eighths inch (6.35 to 9.51 mm.) in thickness. Care is taken that the insert has some bone marrow. The importance of this has been pointed out by several German investigators. Before placing the unbent graft in its bed, its periosteum is incised in many places, so as to allow the underlying osteogenetic cells exit for proliferation, and also an entrance of blood supply to the graft. The graft, firmly embedded under tension in the spinous processes and the dense intraspinous ligaments, afford immediate and excellent fixation of those vertebræ involved even before union takes place. This is confirmed by the immediate disappearance of pain in adults, and pain and night cries in children. The environment of the spinal insert is most favorable: it is not only wedged into healthy spinous processes, which are less than three-fourths inch (19.05 mm.) apart, but is also surrounded throughout its entire extent by ligamentous tissue which is normally attached to bone. The conditions are favorable to a rapid establishment of an haversian blood supply from the spinous processes to the graft. The writer believes that the fact that the spinal graft rarely shows any evidence of disintegration or absorption is explained in this way. Where the kyphosis is marked and angular, greenstick fractures of both halves of the prominent spinous process are produced with this osteotome, and their tips turned in laterally and sutured in contact with posterior surface of the transplant. This produces additional bone contact for graft and reduces the kyphosis by so much.

*Post-operative treatment.* Although it is known from experimental work that the graft becomes united by bony union in four weeks, nevertheless the patient is confined in the recumbent position on a fracture bed for six to eight weeks. After this he is allowed to walk about without apparatus for part of the day. Where a straight graft of sufficient length is used, there is no necessity for a plaster jacket or support. In dorsal cases, where a deformity has developed, necessitating pronounced bending of the graft, a spinal support may be advisable for a few months. It should be emphasized that these cases should be under the observation of a surgeon experienced in this line of work throughout their whole convalescence. The relief of pain and acute symptoms is most satisfactory. External spinal supports, as plaster jackets and braces, should always be avoided, not only on account of their interference with normal function of respiration, but also on account of their injurious effect on

the graft itself, not only from pressure, but in interfering with its function and the stimulus derived therefrom. This is realized by every investigator of bone work.

*Indications for operative treatment.* Fixation by the bone-graft is indicated in all cases, at all ages, where pain or muscle spasm demand immobilization of the diseased vertebræ, and the earlier the operation the more favorable the prognosis. It is indicated for the prevention and correction of increasing deformity, and is even more urgent in the presence of complicating conditions such as psoas spasm, cold abscess or paraplegia.

The only special contra-indication is the inability to secure a clean field of operation. This, however, is rare, as these cold abcesses seldom point in or invade the region of the spinous processes. Uninfected cold abscesses between the spinous processes, however, have not interfered with primary union.

*Prognosis.* The prognosis in all operated cases is most favorable as to relief of all symptoms and increase of deformity. Correction of deformity is most favorable in cases operated early and cases of longer duration where kyphosis is sharply angular or presents a considerable amount of motion. In the one hundred and seventy-eight cases operated, a surprising amount of respiratory mobility was noted in the center of the kyphosis, in all early cases, and in a considerable percentage of cases of even four to six years' duration. These observations were made after the spinous processes were exposed and while the patient was lying prone on a firm surfaced operating table, breathing quietly under an anæsthetic. Under these conditions slight motion only could be detected between the healthy vertebræ above and below the kyphosis. The undoubted reason for this increased motion in the diseased area is the loss of support due to the destruction and absorption of the diseased vertebral bodies, leaving only the lateral masses with their facets and the spinous processes to support the column.

*Paralytic scoliosis.* In cases of very flexible paralytic scoliosis, uncontrollable when the trunk is in the vertical position, where there are sharp angular curves, a graft has been implanted in six to eight of the tips of the transverse processes of the convex side, at the apex of the sharpest curve, after straightening, in a similar manner as that in applying the graft (author's) to Pott's disease.

The treatment of these cases, otherwise impossible to control by external supports such as plaster jackets, corsets or braces, has been much facilitated.

The graft, however, acts only as an adjunct to external supports.

*Spina bifida.* In cases of spina bifida (Fig. 4), where the meningocele has been controlled and a large deficiency of vertebral bone exists, together with weakness, as evidenced by lordosis or other deformity, the bone-graft offers an excellent means for strengthening the weakened spine from the congenital bone deficiency.

The technique is somewhat similar to that adopted in Pott's disease. Modification is necessary on account of the absence of spinous processes and parts of neural arches. The spinous processes above the cleft and the lateral masses of the last lumbar vertebra and the first part of the sacrum are reached from each side by two curved skin incisions, as it is undesirable to interfere with the nerve-tissue which is usually involved in the cicatrix following the operative reduction of the meningocele. The second spinous process above the cleft is split longitudinally and a green stick fracture produced in each half. The first spinous process above the cleft is denuded of its muscular and ligamentous attachments and both sides freshened. Below the cleft the lateral masses of the fifth lumbar vertebra, or the congenitally deformed stumps of the neural arches if sufficiently prominent, and the first segment of the sacrum, which is usually congenitally hypertrophied, are split with the osteotome, and the halves separated to receive the lower ends of the two grafts.

The wounds are packed with a saline compress and the two grafts are prepared and removed from the crest of the tibia, long enough to reach from the split spines above to the sacrum below. The upper ends are beveled, so that when these beveled surfaces come together the grafts form an acute

angle, like an inverted V. The grafts are placed at this angle in the beds prepared for them, and held firmly in place at their bony contacts by drawing the split ligaments over them with interrupted sutures of medium kangaroo tendon. The technique is similar to that of the bone-graft applied for Pott's disease. Skin wounds are closed, and the patient placed on a fracture bed for six weeks.

*Fracture of the spine.* In cases of persistent non-union following fracture of the spine, presenting pain, disability and increasing deformity, the bone-graft is indicated, and should be inserted as for Pott's disease.

It is also indicated in fresh fractures of the spine, spondylitis traumatica (Kümmell's disease) and neuropathic spine (Charcot), where, on account of a rarefying osteitis, crushing of the vertebral bodies and increasing deformity is likely to produce cord compression.

*Tuberculosis of the sacro-iliac joint.* The prognosis of tuberculosis of the sacro-iliac joint, when treated by conservative methods, is most unfavorable. Tubby states that 7.9 per cent only recovered in the moist type when treated by conservative means, in a series of thirty-eight cases. As in the case of bone and joint tuberculosis elsewhere, the prognosis is more favorable in children than in adults. This joint is most unfavorable for external splint fixation, largely on account of its anatomical architecture. Its joint surfaces are oblique, inclining from above downward, forward and outward. Its strength is wholly dependent upon its ligaments. It furnishes no chance for leverage control.

The sacrum, on account of its extreme inclination, is at the disadvantage of being an inverted key to an arch.

Conservative treatment is best carried out by the double Thomas hip splint or the double plaster of Paris spica in conjunction with recumbency during the acute stage.

Internal bone fixation offers the only satisfactory means of immobilization, on account of the above-mentioned anatomical conformation, together with the very powerful muscle action which affects this joint (Fig. 5).

The following technique has been devised by the author for using the bone-graft in this condition and has furnished most satisfactory results: The posterior-superior spine of the ilium, the wing and first posterior spine of the sacrum are reached by a curved incision. The posterior border of the wing of the ilium and the spinous process are split, with their attached ligaments, by a thin osteotome, forming a gutter to receive the ends of the graft.

If practical, a surface on the sacrum is denuded to furnish additional contact with the graft. The wound is packed with a saline compress, and with the patient still in the prone position, the leg is flexed and a graft of sufficient length is removed from the crest of the tibia by the motor saw, as described in the use of the bone-graft in Pott's disease. The width of the graft should be three times the thickness of the cortex. The thickness should include the whole cortex, periosteum, endosteum, and a small amount of the adhering marrow. The graft is placed in its prepared bed, and the ligaments drawn over it by interrupted sutures of medium kangaroo tendon. The skin wound is closed and the patient placed on the back in a fracture bed, for a period of not less than five weeks. There should be no necessity of further mechanical treatment.

In cases of non-union and certain fresh fractures of the vertebræ, when displacement and cord pressure have not occurred, the bone-graft as applied by the author in Pott's disease is applicable for support and fixation.

An illustrative case is that of a young woman, referred by Dr. E. H. Johnson of Naugatuck, Conn. She sustained, in a railroad accident, a horizontal fracture through the middle of the body of the eleventh vertebra. Plaster of Paris jackets were worn continously for one year, at the end of which time support was so necessary that whenever the cast became soft the patient complained of pain and lack of support and asked for a fresh jacket. The tips of the tenth, eleventh, and twelfth spinous processes were exposed through a circular incision to the right turning up the flap of the skin and subcutaneous tissue. These spinous processes were split *en masse* with the attached supra- and interspinous ligaments, with a

scalpel, thin chisel and mallet. A graft of sufficient length was removed from the crest of the right tibia and inserted in the cleft. The split ligaments, with the embedded fragments of the spinous processes, were drawn over it by means of interrupted sutures of medium-sized kangaroo tendon. The patient was kept on a fracture bed for five weeks. The support from graft thus embedded gave immediate relief although no plaster of Paris jacket was applied. At this writing, one year later, there is no evidence of pain or lack of support.

*Ununited fractures.* I have often said that the Lane plate and other internal metal splints, when applied to ununited fractures of long standing, are a hindrance rather than an advantage in securing bony union. This view has been strengthened by the accumulation of experience.

The indications for treatment in fresh fractures and ununited fractures are entirely different, although it is very evident, from the discussion of these problems with various men and the large number of failures seen in our clinics, that many practitioners do not appreciate this difference.

In a large percentage of fresh fractures temporary fixation only is necessary to insure union, as the osteogenetic function of the fragments is active and in the presence of accurate apposition union occurs rapidly. The proper application of the Lane plate in suitable cases may fulfill all requirements.

In ununited fractures the problem is quite different. We have here in the ends of the fragments a marked diminution or an entire cessation of osteogenetic activity. This cessation of activity is evidenced in the marked sclerosis or eburnation which is always found.

The pathology of this condition of sclerosis is very similar to that found in non-ankylosing osteo-arthritis where there is an overdeposit of calcium salts, and a consequent diminution and degeneration of bone-producing cells. The therapeutic requirements of these pseudo-arthroses are fixation, stimulation of osteogenesis on the part of the fragments, and an osteogenetic scaffold connecting the active bone in each fragment back of the eburnated areas. The bone-graft, when inlaid according to the herein-described technique, is the only means of fulfilling these requirements. Two, if not all, of these three essentials are necessary in order to secure union.

The Lane plate furnishes but one of these, viz., temporary fixation, but at the same time it causes absorption and disintegration of bone. The bone transplant not only produces fixation, but also stimulates callus-formation and grows bone on its own part.

Abundant evidence has accumulated to prove that something more than fixation is necessary in these conditions. The most favorable cases for external fixation, such as fracture at the middle third of the tibia, with the fibula intact, have failed to unite in spite of months of effectual splinting and recumbency in bed. Operation showed no interposition of soft tissues and there was no evident reason for non-union.

Codivilla appreciated the above-mentioned therapeutic requirements and met them partially by spanning the fractured area with a very thin autogenous periosteal graft, which has given in the hands of others a fair percentage of good results. But it was not an ideal procedure in that it did not furnish efficient fixation, it did not stimulate osteogenesis between the ends of the fragments, because it was entirely superficial, and it did not penetrate cortical bone structure. Being extra-osseous, it therefore furnished an imperfect graft environment.

Murphy has evolved a better method in his use of an intramedullary dowel, which furnishes more effectual fixation and being entirely intra-osseous, favors stimulation of osteogenesis by better contact of graft to recipient fragments. It is, however, difficult thus to get contact to active bone beyond the sclerosed area, which is most important. It is also difficult of application in small bones, such as those of the forearm, where the medullary canals are small. As in the case of the intramedullary aluminum splint of Elsberg, it is most difficult to secure the necessary lateral fixation in fragments, in such cases as fractures of the ulna and radius, where these bones have been contractured together during long existing non-union.

An illustrative case that will be mentioned later was that of an ununited fracture at the middle of the radius of four years' duration. After four unsuccessful operations, including Lane plating, the radial fragment ends were found closely contractured to the side of the ulna. They were freed with difficulty and held in proper alignment by a long inlay bone-graft. On account of the strong tendency of the angulation to relapse the necessary lateral fixation would have been impossible by any intramedullary splint. The problem was easily solved by the leverage action of a long inlay bone-graft. It is always difficult to get a tight fit of the intramedullary splint into both fragments.

The technique applied in twelve of my cases, namely, fractures of the tibia, shaft of the femur, radius and humerus, was as follows: The fractured area was exposed by a generous skin incision. When the fractured bone is superficial, as in the case of the tibia, the incision is made lateral to the intended site of the bone insert. The skin and subcutaneous tissue are retracted, the bone ends are developed and freshened with chisel, motor burr, or saw, and the sclerosed bone plug is removed from the medullary canal.

If there is overlapping of the fragments the amount of pull required to correct it varies with the degree of overriding at the site of fracture. In the case of a fractured femur in a muscular man, as much as a one hundred and fifty pounds pull may be necessary to secure sufficient extension. In this instance it is far better to set up and adjust a traction pulley apparatus with heavy weights, or use the Hawley fracture table. Either of these provides a constant and uninterrupted pull. If the fragments still overlap and sufficient extension cannot be made to bring them together, it is necessary to trim off the fragments with motor burr, saw, or chisel until good position can be secured. This will produce shortening, but it cannot be avoided.

The fragments are now held in good alignment by an assistant. The periosteum is divided with a knife longitudinally over the bone to be removed in making the gutter for the bone insert. Periosteal flaps are turned back to either side, exposing the bone (Fig. 6).

Two parallel saw cuts, about three-eighths of an inch (9.51 to 12.70 mm.) to one-half inch apart, are made longitudinal in the fragment ends completely through the bone cortex to the marrow cavity with a motor twin circular saw (Fig. 1). The distance between the saw-cuts is arranged by adjusting the distance between the twin saws. These cuts are made from two and one-half to three inches (6.35 to 7.62 cm.) into the end of each fragment from the line of fracture.

While the fragments are held in good alignment, they should always extend far enough from the line of fracture to reach well into the non-sclerosed active bone of either fragment. This distance is subject to considerable variation, depending upon the site of fracture and the amount of eburnation present. The distance the twin saws should be apart, i. e., the width of the gutter for the graft, should be from 5/16 to 8/16 of an inch (7.93 to 12.70 mm.), according to the size of the bone. The revolving saws are kept constantly bathed in saline solution by a spray connected with a sterile tube to a fountain syringe. This prevents the development of excessive heat from friction, which should always be avoided on account of its devitalizing effect upon peripheral bone-cells.

After the twin saws have traveled the desired length to make the gutter for the graft, the bone fragments between the saw-cuts are removed by severing the ends distal from the point of fracture with a narrow osteotome in such a manner as to effect a tongue and groove joint with the ends of the graft (Fig. 10). With motor driven drill holes are bored in the cortex on either side of the gutter, slanting inward to the marrow cavity. These holes are placed near the line of fracture so as to fix the center of the insert. The ends of graft are secured in position by the above-mentioned tongue and groove joint, when feasible, or by additional sutures. This joint is very quickly shaped, and the greater the muscular contracture the more securely is it held in place (Fig. 7).

The exact length of the desired insert is obtained by measuring the gutter and transferring this measurement to the exposed anterior internal surface of the opposite tibia.

A flexible probe is usually satisfactory for this purpose, a right-angled bend marking the exact measurement.

The wound and gutter are packed with hot saline compresses while the graft is being prepared. The patient remaining in the dorsal position, the graft-yielding tibia is exposed by an incision over its crest. The overlying structures are retracted, and the size and shape of the graft are outlined in the periosteum by means of the scalpel with the probe measure as a guide. With the twin saws adjusted to the same distance apart as when forming the gutter, bone cuts are made to the marrow cavity along the antero-internal tibial aspect. With a narrow osteotome or small motor-driven saw or burr the graft is now dislodged and the ends grooved with the motor saw to fit the triangular tongue of the gutter ends.

A double strand of heavy kangaroo tendon is passed through the drill holes previously made. One strand in each fragment is now pulled up from the bottom of the gutter and the graft is placed under them. Traction is exerted on the limb and the graft is forced into position.

A good fit is assured because the same adjustment of twin saws is maintained both in forming the gutter and in removing the graft, and they must be of equal and uniform width through their whole extent. Traction is now removed and the elasticity of the soft parts force the tongue and grooved ends into tighter adjustment. The kangaroo fixing sutures are then drawn taut and tied over the graft.

It is readily seen that this not only affords most effectual fixation but also furnishes a most ideal environment for the bone-graft. It brings each structural layer of bone-graft into close apposition with its corresponding layer in the recipient fragment, namely, periosteum to periosteum, cortical bone to cortical bone, endosteum to endosteum, and marrow substance to marrow substance. Periosteum, and when possible endosteum and marrow substance, are always included in the graft. We have proved by animal experimentation that this close contact of haversian systems assures permanent viability at least of a large portion of the insert. The bone which has been removed from the ends of the graft in order to form the above-mentioned grooves and other normal bone-fragments are finely chipped with a rongeur and pushed between and placed about the ends of the fragments at the line of fracture wherever possible.

These act most effectively as supplementary foci of osteogenesis. Macewen has well pointed out that the osteogenetic efficiency of a bone-graft varies in inverse ratio to its volume. The smaller the graft the greater the relative osteogenesis.

The site of the fracture is covered with the periosteal flaps which were reflected to expose the bone to be removed. This gives two layers of periosteum covering the transplanted fragment. The overlying tissues and skin are closed without drainage. The leg wound is closed in a similar way except that the adjacent muscles are drawn into the cavity from which the graft was taken. Splints are applied and not removed before five weeks.

## ILLUSTRATIVE CASES

CASE 1. M. S., female, 45 years old, always healthy. Four years previously she fell, fracturing the right radius at the junction of the middle and distal thirds, the ulna remaining intact. Fragments reduced under ether. No union occurring in eight weeks, fracture was cut down upon and muscle freed from the bone ends. Good apposition was secured but no union followed. A second open operation was performed and the fragments nailed together. Again no union resulted. At a third open operation the fragments were wired, but again no union followed. Two years after the fracture, at a fourth operation, Lane plates were applied, and this also was followed by non-union. Two years later, four years after the fracture, the patient in desperation consulted me to determine whether something further could not be done, for her arm was both painful and useless.

November 7, 1913 (Fig. 8), the fracture was cut down upon and the Lane plate was found loose in the periosseous tissue. Tips of the screws were found in large circular cavities in bone from which they had loosened. There was a depression in the side of the fragment ends where the metal plate had caused an absorption of bone. The radial fragments, as shown in Figs. 3 and 4, were much shortened from the previous operations and the metal contact, and badly angulated towards the ulna. Their ends were made fresh and with much difficulty their alignment was corrected. This caused the

fragments to retract from each other about an inch. The periosteum on the outer side of each fragment was incised distally from the fracture for two and one-half inches and retracted, exposing the bone.

By means of the motor saw and osteotome a gutter was made in the fragments, according to the above-described technique, about three-sixteenths of an inch (4.75 mm.) wide and three and one-half inches long.

With the motor saw a graft three and one-half by seven-sixteenths by three-sixteenths inches (8.89 cm. by 11.09 mm. by 4.75 mm.) was removed from the anterior internal aspect of the tibia and trimmed with the saw so that it fitted tightly into the gutters in each fragment.

The strong tendency of the angular deformity to relapse was prevented, and the fragments were held very securely by the heavy kangaroo bone suture previously described. A plaster of Paris cast was applied and upon its removal five weeks later firm union of the fragments had occurred in good position (Fig. 6).

CASE 2. H. C., male, 28 years old, in an automobile accident in Scotland, April 5, 1911, sustained a fracture at the middle third of the right tibia and fibula. The fracture was reduced and placed in a plaster of Paris splint. Seven weeks later no union had occurred and Bier's hyperæmia was applied for four months at a hospital in Scotland. No union resulted. One year after the fracture, with non-union, I cut down on the tibia and inlaid a graft five inches long according to the above-described technique. It was not deemed necessary to disturb the fibula. In five weeks firm union had occurred. Excellent function existed twenty months after operation.

UNUNITED FRACTURE OF NECK OF FEMUR

In cases of ununited fracture of the neck of the femur the bone-graft is even more necessary than in the shaft of long bones, for here the mechanics, blood supply, and osteogenetic conditions are much more unfavorable to union.

This is exemplified by the case of a young woman who received a fracture of the neck of the femur and four months later non-union was evident. The pseudo-arthrosis was cut down upon, the ends of the fragments were freshened, and the fragments were held together by a long square tin-plated spike driven through the great trochanter and neck into the head. A long plaster of Paris spica was worn for ten weeks. Primary union of the soft tissues resulted. Much bone absorption about the spike occurred and non-union resulted.

The above experience, among others, has induced the author to evolve the following technique for the use of the bone-graft in place of the metal spike.

*Illustrative case.* Female, 60 years old (Fig. 9). Non-union of neck of the femur of five months' duration. The point of fracture was reached through an anterior incision from the anterior spine of the ilium downward for five inches. The ends of the fragments were freshened by chisel and sharp curette. A point just below the great trochanter was reached by a short lateral incision.

The proper location through the center of the neck and the direction of drill hole for the graft were determined by thrusting a small hand drill through the great trochanter obliquely upward through the center of the neck and into the center of the fractured end of the capital fragment, as felt or seen through the anterior incision. This may necessitate the withdrawal and reinsertion of the drill. When the proper location and direction for the drill hole were determined the large motor-driven drill was pushed inward along the direction previously determined through the center of the neck and well into the head. This drill, made after my directions, produced a hole six-sixteenths of an inch (9.50 mm.) in diameter. The drill was then disengaged from the motor and left in position to hold the fragments in apposition while the bone-graft was being removed from the crest of the opposite tibia.

This graft was removed by the motor saw and was about four inches long by six-sixteenths to seven-sixteenths inch (9.50 to 11.09 mm.) in cross-section. My doweling instrument, which turns out a dowel of proper size to fit the drill hole, was then adjusted into the motor (Fig. 6).

While the motor was held by an assistant I fed the graft slowly into the doweling instrument. This was done with comparative speed and assured a perfect fit. This strong graft was driven into place by a metal mallet. The operative technique was precisely the same as when the metal spike is used. The skin was closed without drainage. In six weeks there was firm union. Six months after operation the patient walked about without pain and with perfect function.

The inlay bone-graft as applied in the seventeen cases of pseudo-arthrosis herein mentioned has given 100 per cent of bony union.

On account of the eburnation which always exists in the ends of fragments in cases of pseudo-arthrosis, it is advisable to use healthy bone from elsewhere in the body, as from the tibia for example.

*Fresh fractures.* In cases of fresh fractures (Fig. 10), however, the bone being osteogenetic, the graft material can be taken from the fragments themselves and used to advantage. This is best done by making the saw-cuts in one fragment just double the length of the

Fig. 1. The author's modification of the Hartley-Kenyon motor. The right angle arm for saw with gear for reducing speed of saw, and the tube, on the left, for constant spray of saline solution on saw from an elevated douche bag are recent and important improvements. The above-mentioned twin saw is shown in the left upper corner of the illustration; this can be easily and quickly adjusted into motor in place of single saw already there. For technique of its use see text.

other and transposing the two strips of bone. This has been done in two of my later cases of pseudo-arthrosis, and in all cases of recent fresh fractures the inlay graft as well as its gutter site has been so formed that they are about 6.35 mm. wider at their periosteal surface than at their endosteal surface. This wedge-shaped cross-section of graft and its gutter prevents the graft from slipping into the marrow cavity. This is of especial advantage in all operable cases of fresh fracture, because the medullary canal is never filled, as is the case in long standing non-union. The graft is held in place by autogenous dowel grafts placed obliquely into the cortical bone on either side of gutter with their ends projecting over and in contact with the periosteal surface of the graft. This affords a fixation practically as secure as that of the Lane plate and without the use of any foreign substance. The grafts are removed from the fragments by starting the cuts with the twin motor saw adjusted to about seven-sixteenths inch (11.1 mm.) apart in a femur, then completing the cuts through the cortex to the marrow cavity with a single motor saw. The longer strip of bone is then inserted into the gutter so that half of it is in one fragment and half in the other.

Dowels are now turned out with the motor doweling instrument, using for this purpose either the shorter strip of bone or bone removed from the side of the gutter distal from point of fracture.

The graft is then forced into place and four holes drilled obliquely to its side into the cortex of the gutter. The dowels are then driven into place, allowing their ends to project over and in contact with the periosteal surface of graft.

The inlay graft thus inserted affords as secure immediate fixation as the Lane plate.

This as well as other similar technique would be impossible without resorting to the motor saw. The proper use of the motor saw, by shortening the time of operation, lessening the traumatism, and affording a means for accurately shaping the bone-grafts and their beds, has opened up a very wide field of application hitherto impossible of development.

Fig. 2. A very acute case of tuberculosis of lumbar spine, three months after bone-graft was inserted. Child has remained well one year after operation.

Fig. 3. Lateral skiagram of dorsal spine with graft bent into and united to the spinous processes. There was a large kyphosis in this case, of long duration and only a small amount of correction. This illustration used here to demonstrate the desired location of the graft in the tips of the spinous processes and the amount it was possible to bend the graft and still hold it by the ligaments drawn over it.

There are many technical difficulties in connection with bone work which could never be overcome except by assistance of the motor saw and its various adjustable attachments.

In the repair of deformity and the result of traumatism of the skeleton the advantage of the use of its own material and of the avoidance of the former seemingly necessary foreign substance has been clearly demonstrated.

Metal introduced into the tissues is in most respects the direct antithesis of the bone-graft. It favors infection, absorption, and disintegration of tissue.

The bone-graft being living tissue has certain germ-resisting properties. It immediately becomes adherent and fixed to the contacting tissues. It not only stimulates the bone with which it is contacted to increased osteogenesis but it proliferates bone of its own initiative.

### ERASION OF THE KNEE-JOINT, WITH BONE TRANSPLANTATION

This procedure is for the treatment of acute adult tuberculosis and the correction of

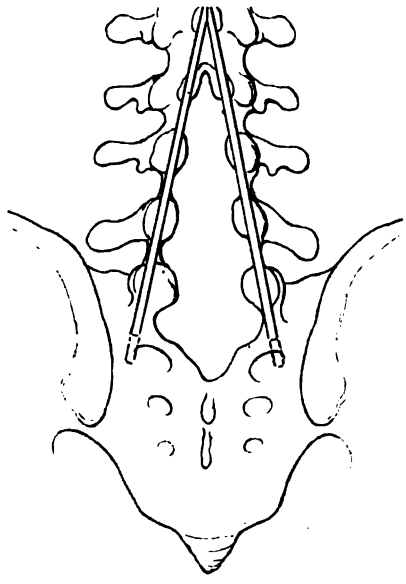


Fig. 4. Diagram showing author's method of straightening or supporting bifid spine (spina bifida) by the insertion of autogenous tibial grafts.

complicating deformities, as fibrous or incomplete bony union.

Before entering the tuberculous joint a graft, eight inches long, is removed from the anterior internal surface of the tibia by the twin saw, adjusted seven-sixteenths of an inch (11.09 mm.) apart, and placed in saline solution until wanted. If the patella is not too much involved it has been used by the writer instead of the tibial graft. By sawing it into inlay grafts it serves the purpose very well.

With an Esmarch bandage about the upper thigh, the knee-joint is reached by a large U-shaped incision, with the lowest point of the curvature over the tubercle of the tibia. The ligamentum patella is divided at its insertion, and the patella is turned upward and removed. The lateral ligaments are cut and the leg flexed on the thigh to the extreme.

The tubercular soft tissue is trimmed away with scissors. With a narrow bow saw a thin section consisting of the cartilage, with the underlying bone (6.35 mm. to 8.46 mm. in thickness) is removed by a saw cut, approximately parallel to the convexity of the condyles of femur. With the same instrument a section about the same thickness is

Fig. 5. X-ray taken three months after the insertion of two autogenous tibia grafts for lumbar sacral and sacro-iliac tuberculous ostitis. a, b, is spinal graft inserted into spinous processes of the fourth and fifth lumbar vertebræ and the first two spines of the sacrum. c, d, is the second graft which has been mortised into graft a, b, inserted into posterior wing of the ilium.

It is six months since this child was operated and he has played about with other children without evident symptoms for the past four months, although wearing no external support.

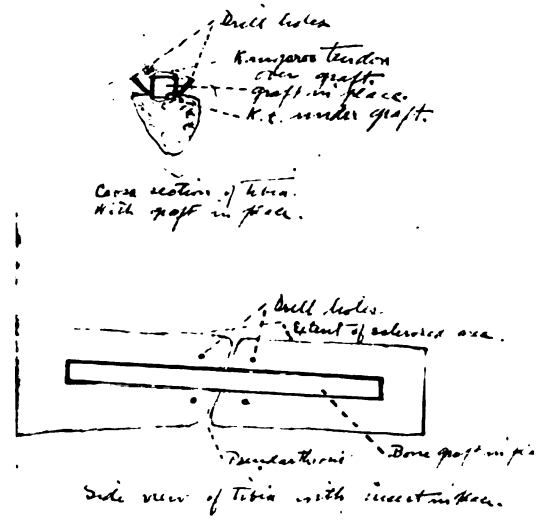


Fig. 6. Cross-section of tibia with graft and sutures in place; also longitudinal surface alignment of fragments with graft implanted.

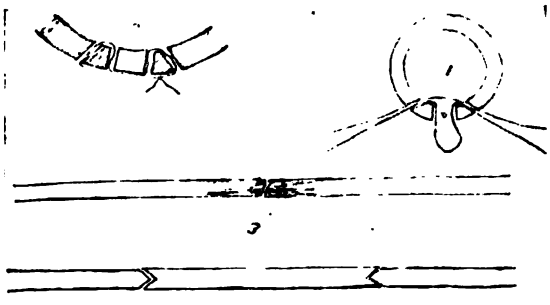


Fig. 7. 1. Illustrates two strands kangaroo tendon passed through drill holes ready for graft to be slipped into gutter with one strand above and the other under the graft. 2. Ends are brought over graft area and tied. 3. Longitudinal section of long bone, illustrating sclerosis at the fracture ends, also graft dovetailed into position.

removed from the head of the tibia by a concave cut, producing a surface which will fit over the convex surface already prepared on the condyles of the femur.

The bone should be so removed that when the cut surfaces are approximated the leg is straight.

The anterior lateral surfaces of the upper end of the tibia and the lower end of the femur are each exposed for about three inches.

The periosseous structures are incised down to the bone, on each side of the patella, on both tibia and femur, parallel with their long axes, and turned sideways with the periosteum elevator.

With the circular motor twin saws adjusted the same as when removing the graft and the tibia, and femur held in good apposition, two parallel cuts are made two inches into each bone at their antero-lateral corners on either side of patella. The strips of bone between the saw-cuts are removed with a small motor burr and narrow chisel.

Holes to receive graft-retaining kangaroo sutures are made in the cortex laterally to the gutter in each bone, or the grafts may be held by autogenous dowel grafts as described in author's technique for ununited fractures. The sutures are inserted by large curved needles or flexible probe, and pulled up from the bottom of the gutter in the form of large loops, under which the graft is placed and pressed into its bed. The sutures are then drawn tightly in place over it and tied. The graft, thus applied, assumes efficient fixation and supplies an active osteogenetic factor and stimulus to the bones into which it is inserted without the use of foreign material, as metal plates, screws, or wire.

The necessity in these cases for some internal fixation has been appreciated in the orthopedic service of the Massachusetts General Hospital, according to Dr. Goddu, since December, 1909, and internal metal plates and clamps have been used in all excisions of knees, and even under these conditions two out of eight cases required re-excisions, on account of inability to form sufficient callus. Goddu mentions twenty-seven cases done in three years, of which four only showed union within six to twelve weeks; four required re-excision, in one case silver wire had to be removed on account of a discharging sinus.

"In three cases where the bones were drilled and held by suture material, in one the suture broke, allowing displacement of the ends of femur and tibia, and a reposition under ether was necessary; in one other there was considerable motion at the end of eight weeks."

On account of similar experience the author has used, instead of the metal plate, the inlay bone-graft, which he believes is far superior.

PARALYTIC AND CONGENITAL DISLOCATION OF THE HIP.—AUTHOR'S ARTHROPLASTY WITH BONE GRAFTING.

In paralytic dislocation of the hip, the rim of the acetabulum is much worn — or, as it seems, absent — when slipping the hip in and out.

The capsule is much relaxed and the muscles about the hip lengthened.

Cases of congenital dislocation of the hip that have been reduced by the bloodless method (Lorenz, Calot) two or more times become somewhat similar to those of paralytic origin, except that the periarticular tissues being properly innervated are, although much stretched, not nearly as lax or flaccid. In some cases the head slips in and out of the acetabulum with as much ease as in the case of the paralytic hip. In most cases, however, a reduction can only be accomplished when

Fig. 8. These are skiagrams of the ununited fractures of the radius described in the text. a, Shows the radius after four years of non-union and four operations and the Lane plate in position two years after its application. Much destruction of bone has resulted with a consequent shortening of the radius. b, Shows the graft in place with firm union of graft to fragments. The ends of the fragments separated and the radius lengthened about 2.50 cm. Firm union and a good functional arm is the result at this writing, five months after insertion of inlay graft.

the child is under an anæsthetic; in either event the hip slips in and out of the acetabulum with evidence of an insufficient acetabular rim.

The first is best obtained by the formation of an efficient acetabular rim and a proper tightening of the relaxed capsular ligament, the second by a minimum interference with joint cartilage. Hoffa's operation, of deepening the acetabulum by the removal of cartilage and bone, has been the one of choice. Its disadvantages, however, are great in that it may result in an immediate marked limitation of motion, and pain. Even good functional joints resulting from this precedure have, years after, become painful and much limited in their motion, undoubtedly largely due to an extensive removal of cartilage and an exposure of a large surface of bone which is prone to proliferate.

The anatomical defects, it seems to the author, are best overcome by the following operation:

### AUTHOR'S TECHNIQUE FOR RECURRENT DISLOCATION OF THE HIP

The hip is reached by a lateral incision and the turning up of the upper part of the great trochanter together with the attached muscles (Fig. 11).

The capsule of the superior part of the joint is developed without incising it. With a wide, thin osteotome a broad bone incision about one-half to two-thirds of an inch above, and parallel with the superior edge of the acetabulum, is made obliquely down to the

Fig. 9. X-ray case, female 60 years old; ununited fracture of the neck of femur repaired by dowel graft removed from tibia and shaped to fit drill hole.

Note new bone protruding from outer end of graft. Operation resulted in firm union.

joint cartilage at a point about the same distance internal to the edge of the acetabulum. A sufficient reef is then made with silk sutures in the posterosuperior or overstretched part of the capsule in order to tip down the loosened edge of the acetabulum and thus hold it in that position so as to form an exaggerated acetabular rim. This opens up a wedge-shaped cavity above the acetabular rim by the displacement outward of the bone fragment.

Measures of this cavity are taken with calipers and a wedge bone-graft is procured either from crest of the tibia or the remaining portion of the great trochanter. If it is necessary to shorten the trochanter muscles, the graft is always removed from the base of the trochanter; and when the reflected portion of the trochanter with its attached muscles are replaced, its position is lower by the thickness of the wedge graft removed, thus tightening the muscles to that extent.

The graft is drilled and fixed in place by two sutures of medium kangaroo tendon. The transplant thus fills the wedge cavity above the acetabulum at the same time that it assists the shortened capsule in holding the fragment in its new position.

This procedure preserves all the joint cartilage, is not difficult of execution, and fulfills every anatomical requirement.

### THE BONE WEDGE GRAFT IN TREATMENT OF CLUB-FOOT

The severer types of club-foot in children over two and one-half years of age may be considered under two groups, in order to simplify the description and choice of method of treatment. The salient characteristics of the first group are a foot not markedly shortened, but marked adduction of the forefoot, moderate varus, and equinus. The heel is well formed, but much elevated and cannot be brought to the ground. The inner border of the foot is concave and shorter as compared to the outer convex border; the cuboid, if hypertrophied and prominent, is only moderately so. The foot is somewhat smaller than its fellow, due to under-development.

In the severer, or relapsing, cases of this group, when the tarsus resists correction by tenotomies and wrenchings, it is remodeled by placing a bone-graft into the inner short or concave side of the tarsus at the point of its greatest concavity, which is at the scaphoid bone.

### AUTHOR'S TECHNIQUE OF THE APPLICATION OF THE BONE

*Graft wedge* (Fig. 12). In addition to preparing the deformed foot for operation, the leg is also prepared at the same time. A subcutaneous tenotomy of the tendo Achillis is done, and the equinus deformity is corrected. It is important that the heel should be thoroughly brought down, using the foot as a lever over the lower end of the tibia. With the foot on a sand bag, a U-shaped incision is made and a flap of skin and subcutaneous tissue is turned back sufficient to expose the inner aspect of the scaphoid. With a sharp osteotome the scaphoid is split into anterior and posterior halves.

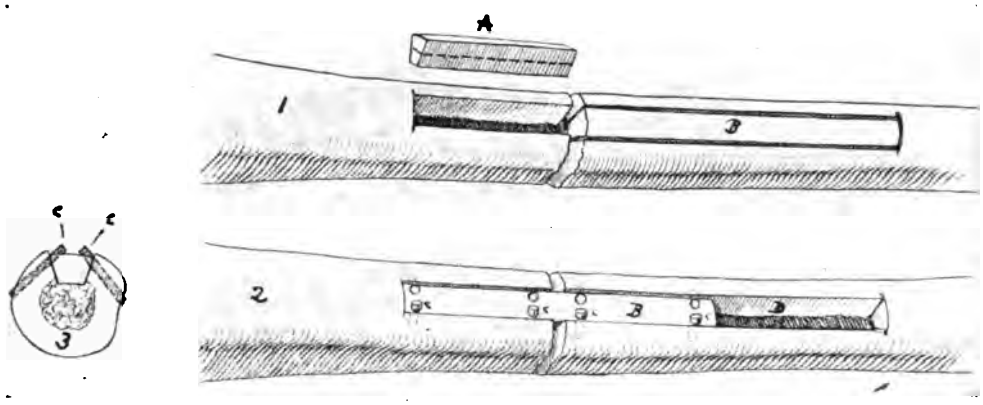



Fig. 10. Diagram illustrating the application of the inlay graft to fresh fractures, preferable to the Lane plate. On account of the absence of any marked pathological change in the fragment ends of fresh fractures, bone material from this source can be used to advantage as can be seen from the cut. In 1′ a and b are removed with motor saw; a is split into two or three long strips of bone which are made round and of proper size (c, c, c), with author's doweling instrument, b is then placed in position as indicated in 2′ and 3′ and firmly held by the dowels (c, c, c). The space in the cortex, d, remains empty.

The correction of the adduction and varus deformities is accomplished by the forced separation and readjustment of the planes of the scaphoidal halves. While an assistant holds the foot in strong over-correction, the distance between the scaphoidal halves is determined by calipers. The wound in the foot is then packed with saline compress. The crest of the tibia of the other leg is now exposed below the tibial tubercle, and a wedge graft is outlined in the periosteum by a scalpel one-eighth to one-fourth of an inch thicker than indicated by the caliper measurement previously taken of the scaphoid cavity. With the small motor saw, cuts are made along the periosteal incision through the bone cor-

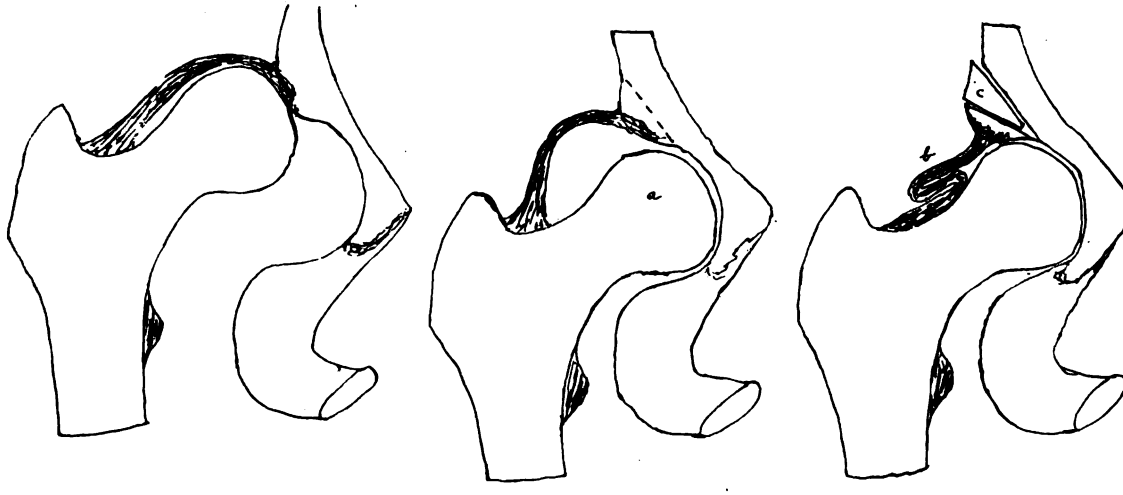



Fig. 11. Diagram of arthroplasty with the application of the bone wedge graft, for paralytic dislocation of the hip and cases of congenital dislocation when the head of the femur will not stay in the acetabulum on account of the shallowness of the acetabulum and the absence of its rim. a, Represents the head of the femur reduced and in the acetabulum. The capsule is shown much overstretched and the acetabular rim absent. The dotted line indicates bone section from just above the insertion of joint capsule down to the top of the joint. b, Shows the capsule reefed with silk sutures and the postero-superior portion of the acetabular edge pulled downward forming a lip, to aid the shortened capsule in holding the head in place. c, Is a wedge shape graft placed in the cavity of the same contour between the cut surfaces of the new acetabular lip and the pelvis.

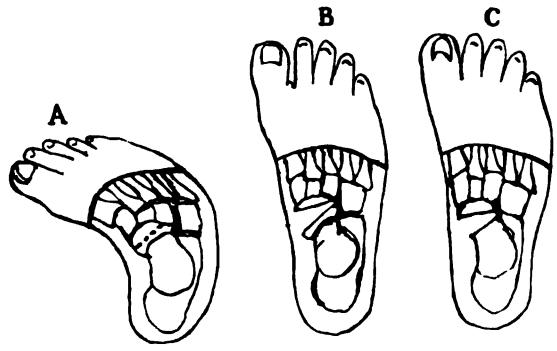



Fig. 12. a, Is diagram showing the element of adduction deformity of a congenital club-foot. The dotted line indicates where the scaphoid is split. c, Shows the foot after osteotomy of the scaphoid and forcible correction of the adduction and varus deformity by the separation of the scaphoidal and a rotation, at that point, of the forefoot on the posterior part of the foot. A wedge, cuboidal, or tibial graft may be used to fill this space, according to the severity of the deformity and hypertrophy of cuboid. b, Indicates the cartilage removed from the posterior surface of the scaphoid and the head of the astragalus in a case of acquired paralytic club-foot (talipes equinovarus) with hypermobility. A correction of the deformity causes a separation of these two cut bone surfaces. The cavity is filled by a wedge tibial graft.

tex. Before disengaging the graft from its bed, drill holes are made in its center with the motor drill. The graft is then removed by wedging a thin narrow osteotome into the saw-cuts, and is threaded on a strand of medium kangaroo tendon, each end of which is threaded into a strong cervix needle.

One needle is forced through the anterior half of the scaphoid from the cut surface side by a strong needle holder, and the other through the posterior half from its cut surface side. In older cases, a drill may have to be substituted for the needle, on account of the density of the bone.

The graft, which is slightly larger than the cavity in the scaphoid, is then forced into position between the two halves of the cut scaphoid, thus closing up the tarsal joints which have been separated anteriorly and posteriorly by the force exerted by the assistant in correcting the foot. The kangaroo tendon suture is then drawn taut over the graft and tied. The periosseous structures are drawn over the graft and sutured with chromic catgut, and the skin wound is sutured with plain catgut.

With the foot over-corrected and the knee flexed to a right angle, a plaster of Paris cast is applied from the toes to the groin. This is allowed to remain on for four weeks, and is followed by a cast from the toes to the knee for an additional four weeks.

In cases presenting a very short foot, more marked varus, and a hypertrophied cuboid, the graft is taken from the posterior part of the cuboid on the outer side of the foot and inserted into the scaphoid by precisely the same technique as that carried out in the tibial wedge graft. These incisions produce a complete transverse section of the bones of the tarsus, and allow the forefoot to be not only swung outward at this point but to be rotated about the cuboscaphoid ligament.

As this ligament lies approximately equidistant from the inner border of the scaphoid and the outer border of the cuboid, it is the center of a circle of which a wedge taken from the cuboid is a sector, and when used to fill the gap formed by splitting the scaphoid and correcting the foot it exactly fits and at the same time the gap formed by its removal from the cuboid is closed.

The foot and limb are fixed to the groin in a plaster of Paris dressing, with the foot well over-corrected and the knee flexed. This dressing should remain on for four weeks, followed by a second plaster of Paris dressing to the knee, to remain on eight weeks.

### THE ADVANTAGES OF THE BONE-GRAFT IN CLUB-FOOT

It lengthens the foot, already much shortened. By permanently lengthening the short side of the skeleton of the foot, it insures in a most trustworthy way against a relapse of the deformity. No joint is involved by the operation, therefore it does not cause an interference with joint function or mobility.

*Acquired club-foot (paralytic varus).* This type of deformity is due to unbalancing of the foot by paralysis or weakening of the peroneal muscles. The outer border of the foot drops, the forefoot adducts, and the child walks upon the outer edge of the foot, forcing it into further adduction, and causing an increasing hypermobility at the astragaloscaphoid joint, resulting in a deformity very

Fig. 13.

Fig. 14.

similar to that of a congenital club-foot. The requirements for treatment are very similar to those of congenital club-foot, with the addition, of necessity, of the control of the hypermobility and dropping of the outer border of the foot.

*Author's operation for paralytic club-foot* (Fig. 13). The tendo Achillis is tenotomized, if shortened. The astragalo-scaphoid joint is reached by a U-shaped incision and turning up of a flap of skin and subcutaneous tissues. With a sharp chisel or osteotome all the cartilage is removed from the posterior surface of the scaphoid and the head of the astragalus. The foot is over-corrected and the antero-posterior diameter of the cavity is taken between the cut bone surfaces of the scaphoid and astragalus. The wound is packed with hot saline compress. The tibia is laid bare about three inches below the tubercle of the tibia. The dimensions of the required graft are outlined by a scalpel in the periosteum. With the small motor saw cuts are made completely through the bone cortex. With the motor drill two holes are drilled through the cortex of the graft, before it is disengaged from the tibia. The transplant is then removed from its bed with a chisel and threaded upon one or two strands of kangaroo tendon, the ends of which are threaded into strong cervix needles; one needle is forced through the inner border of the scaphoid from the cut surface side, and the other is passed through the inner surface of the head of the astragalus from the cut surface side. The graft is pushed into position between the astragalus and the scaphoid, the sutures drawn tight and tied over the graft. The periosseous tissues are drawn over the graft and sutured with chromic catgut and the skin wound is closed by continuous plain catgut suture.

If the peroneal muscles are entirely paralyzed, the varus or dropping of the outer side of the foot can best be controlled by using the tendons of those paralyzed muscles for ligaments.

The peroneal tendons and external malleolus are exposed by a curved incision with its convexity posterior. An osteo-periosteal flap, one inch in its vertical diameter and two-thirds of an inch in its antero-posterior diameter, is turned posteriorly by a chisel on the periosseous and periosteal tissues as a hinge. The peroneal tendon sheaths are split for a considerable distance up and down from opposite the periosteal flap, and the tendons are brought forward and placed beneath the osteo-periosteal flap, which is sutured over them with silk. Additional silk sutures are passed through the upper and lower edges of the osseous flap, through the tendons, and into the periosteum and periosseous tissues of the fibula beneath the tendon.

It is important that the foot is held over-corrected and that the tendons are held taut while the sutures are placed in position (Fig. 14). The skin wound is closed by continuous

catgut sutures. With the foot held in over-correction, and the knee flexed, a plaster cast is applied from the toes to the groin. This plaster should be removed at the end of four weeks and be replaced by another reaching from the toes to the knee for an additional six weeks. It should be determined in individual cases whether support by braces is needed.

If it is not desirable to use the peroneal tendons for ligaments because the muscle power is not entirely lost, silk ligaments may be inserted between the tip of the external malleolus and the cuboid, to fortify the weakened muscles. This is best accomplished by short incisions over the external malleolus and cuboid, and the silk ligaments passed under the skin by tunneling with a blunt-eyed probe or a broad ligament clamp. The ends are inserted into the bones of the external malleolus and cuboid by strong cervix needles or by drilling. As there is danger of the untying of knots of heavy silk, fine silk is tied around each half knot.

Post-operative convalescence is carried out in precisely the same manner as when the tendons are used for ligaments.

*Advantages of the above method.* Adduction and varus are corrected. The adduction is overcome by lengthening the inside of the foot and fixing the scaphoid opposite at anterior surface by the mechanics of a wedge.

Hypermobility is controlled and a stable foot is produced. The mechanical balance of the foot is much improved. The anterior tibial muscle, an active factor in producing the deformity, is restored to its normal function. In certain cases when the anterior tibial is well developed and the peroneal muscles are paralyzed, the adduction of the foot is over-corrected by inserting a large wedge graft; the anterior muscle is thus made to do more than its normal work by overbalancing the foot.

## CONCLUSIONS

1. My experience as to the trustworthiness of the bone-graft, as surgical agent, when taken with its enveloping membranes (periosteum and endosteum) and contacted with bone, has been borne out by Murphy, McWilliams and others, who have obtained practically 100 per cent of successes. In my last one hundred cases the successes have been 100 per cent.

2. The endosteum, marrow substance, and periosteum should be included on the graft, as they play a most important rôle in aiding to establish an early and sufficient blood supply from the recipient tissues to the cortical part of the graft. The endosteum is also actively osteogenetic as well as the inner layer of the true periosteum.

3. A rapid and complete union between graft and recipient bone should be in many cases enhanced by the interposition of numerous small grafts in which the periosteum may be disregarded because of the easy access of blood supply to their interior osteoblasts. These coalesce with each other and also with the recipient bones and the large graft.

4. The living bone-graft has certain bacteria-resisting properties, as evidenced by two of my animal experimental cases where sepsis occurred and parts of each graft became united to the recipient bones, while the rest of the transplant succumbed to the infection and requestrated.

5. The bone-graft apparently acts always as a stimulus to osteogenesis to the bone into which it is ingrafted or contacted.

6. The bone-graft when well contacted becomes immediately adherent to the recipient bone by newly formed tissue, which changes to solid bone within four weeks' time. This together with its bacteria-resisting property strongly favors, in the author's opinion, the substitution when feasible of the bone-graft in place of all metal internal splints, especially when it is appreciated that metal has the opposite effect to the graft, in that it inhibits callus formation, produces bone absorption, and favors infection.

7. The dowel, the inlay and wedge bone-graft afford a means of repairing and remodeling the skeleton which the surgeon has not hitherto possessed.

# COMPOSITE OR FIBRO-EPITHELIAL TUMORS OF THE LIPS

By WALTON MARTIN, M. D., New York City

THE following case seems sufficiently unusual to make it of interest:

A boy, fifteen years old, had noticed two years previously, a small mass, about the size of a pea, in his lower lip. This mass had gradually increased, so that the lip was pushed forward. There had been no pain or discomfort; he wished simply to be relieved of the deformity. The boy had always been in good health. He had no similar swellings. The teeth and mouth were normal. His family history was negative.

*Examination.* On examination there was found embedded in the substance of the lip near the middle line, an oval swelling with the long axis of the oval in the sagittal plane of the body about one-half inch in length and one-quarter inch in width. It was tense, firm, and freely movable. The skin was tightly stretched over the little mass, and the mucosa of the mouth to a less extent. It was not tender and there was no heat or redness in the surrounding areas. The portion of the tumor presenting under the skin looked whitish.

*Operation.* Through a small linear skin incision, under cocaine anæsthesia, the small tumor mass was readily enucleated by blunt dissection.

*Specimen.* The specimen removed was an elongated tumor three-eighths inch by five-eighths inch, slightly constricted in the middle. It was obviously made up of two parts, one mainly cystic, the other solid. On section these two parts became even more evident. The solid portion was firm and suggested the appearance presented by the so-called mixed tumors of the parotid.

*Microscopical examination.* Under the microscope the tumor was seen to be enclosed in a fibrous capsule. From this capsule a strong band passed inward, dividing the tumor into two parts and giving it the appearance of being constricted in the middle, as seen macroscopically. Derived from the connective-tissue capsule and this main connective-tissue partition, secondary septa passed into its substance. In places this connective tissue changed gradually into a more cellular, mucoid tissue. The connective-tissue framework and the mucoid tissue were moderately vascular and together made up about one-eighth of the tumor. The rest was made up of cysts of various sizes lined with columnar, cuboidal and somewhat flattened epithelial cells, with deeply stained nuclei, arranged in layers, and of solid masses, bands, bars or strands of epithelium, lying in the basement membrane. The microscopic appearance again is similar to the so-called endotheliomata or mixed tumors of the parotid.

Scattered through the medical records are reports of similar labial tumors. One was described by Sir William Lawrence in 1831. It was the size of an English walnut and contained not only cartilage, but also a small portion of bone.

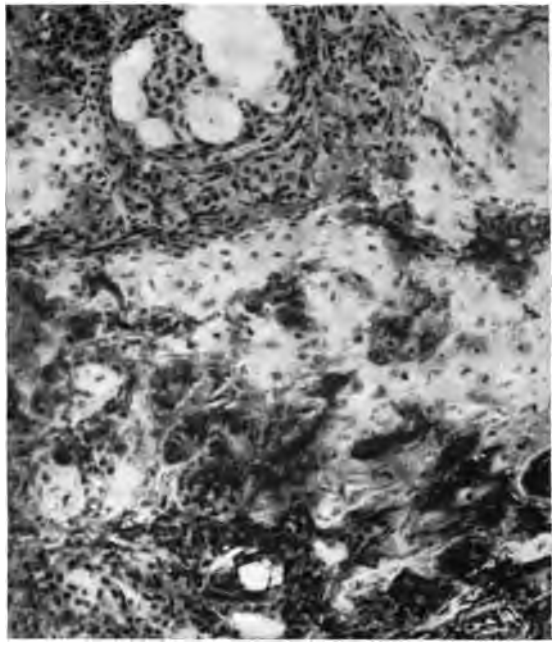
In his lectures on surgical pathology, Sir James Paget referred to two specimens he had had an opportunity of examining. In neither specimen was cartilage found.

Broca, in Duplay's Surgery, in his article on labial tumors gives a good description of these new-growths under the heading of mixed tumors of the labial glands. He refers to the reports of ten cases.

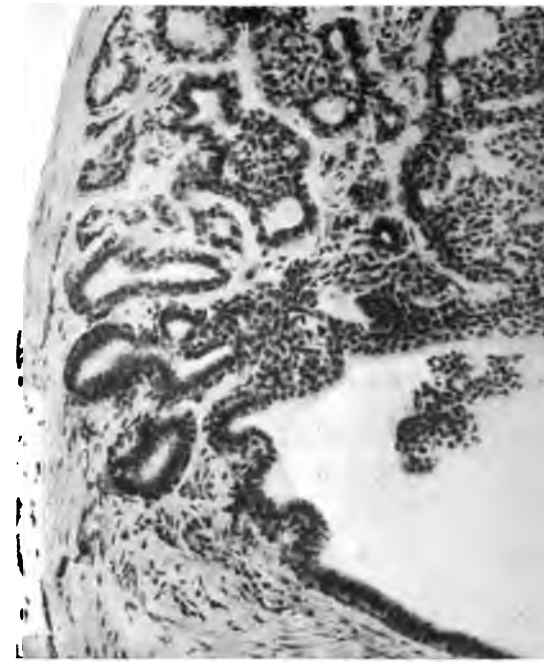
Ribbert in his Geschwülstlehre (1904) under the heading of composite tumors of the salivary glands, describes a similar tumor that he had examined, taken from the upper lip. In the *Précis de Pathologie Chirurgicale*, under the heading of tumors of the lips of salivary origin, an account is given of these neoplasms.

Beneath the mucosa of the lip, interposed between it and the orbicularis oris, is a layer made up of glands. These glands are embedded in the submucous connective tissue and are surrounded by fat. They are acinous glands provided with excretory ducts which open on the surface of the mucous membrane in the oral cavity. Recent investigation has shown that they belong apparently to the so-called mixed type of salivary glands, like the submaxillary and sublingual.

New-growths arise in these labial glands just as similar tumors arise in one of the other salivary glands. Clinically they are benign. The disfigurement that they cause insures their early removal, possibly before they have an opportunity of undergoing



A. 300 X. Connective-tissue stroma showing cartilage elements, in upper left-hand corner. Cells undergoing mucin-like degeneration.



D. 300 X. Demonstrating capsule, stroma and numerous epithelial alveoli.

malignant change. For it is well known that similar growths in the parotid, after many years of slow growth, may show signs of great malignancy and rapid growth. They are uncommon, and almost all of the reported cases are of the upper lip. The situation of the growth in the lower lip, described above, is very unusual.

E. 20 X. View of a slice from entire tumor; showing capsule and relative proportion of cystic to solid tissue. A. and D. show portion cut out for photomicrographs.
(From the Laboratory of Surgical Pathology, College of Physicians and Surgeons, Columbia University, N. Y.)

Without entering into a discussion of the correct classification of this interesting group of tumors (made up of epithelial cells, cartilage, bone and connective tissue), I will simply present Ribbert's views. He explains in a footnote that the heading "Composite Tumors" (Zusammengesetzte Tumoren) was a misprint; that these growths are really fibro-epithelial tumors. He groups them with fibro-adenomata of the breast. He believes that the changes into cartilage, mucoid tissue and bone are all forms of connective-tissue metaplasia and that, if the tumors are carefully enough examined, transitional places will be found where the connective tissue passes gradually into mucoid tissue and this into cartilage and bone. He divides them sharply from *true* mixed, or as he prefers to call them composite tumors, such as are found in the mouth and the sacrococcygeal regions, epignathii, teratomata, etc. He believes that the cellular masses are epithelial, not endothelial (a view held by Volkmann).

The sections of this little tumor are very interesting in reference to this point of view.

# AN IMPROVED GILLIAM OPERATION FOR UTERINE DISPLACEMENTS[1]

WM. CUTHBERTSON M. D., CHICAGO

DISPLACEMENTS of the uterus may be divided into anterior and posterior displacements and descent. The anterior and posterior displacements may be subdivided into flexions and versions, and descent into the first, second, and third degrees. The operation which I am about to describe is applicable to the retrodisplacements and the first and second degrees of descent.

The normal uterus is maintained in its normal position in the pelvis by the pelvic fascia and the connective tissue surrounding the blood-vessels of the organ. As it appears in the normal state when the abdomen is opened, it is pale pink in color, of a moderately firm consistency on palpation, and lies in moderately anteflexed position with its fundus pointing forward and upward, towards the symphysis pubis. None of its ligaments, the round, the broad, nor the uterosacral, are on the stretch. It is freely movable, laterally, anteriorly, posteriorly, and upwards and downwards. After these various movements it assumes its normal position automatically.

*Etiology.* To produce any of the different displacements of the uterus, often the first thing to occur is interference with its circulation, accompanied or not by traumatism or infection, which results in an increase in its size and weight. This circulatory disturbance may be caused by, first, pregnancy; second, infection; third, congestion;— the first two frequently being accompanied by traumatism.

1. When normal pregnancy occurs followed by a natural delivery without any infection and a proper puerperium being maintained, the uterus undergoes involution and it resumes its normal position in the pelvic cavity. When, however, infection occurs, or the uterus is badly traumatized during delivery, subinvolution follows which, of course, alters the size and weight of the uterus.

2. When from any of the numerous causes, infection of the non-pregnant uterus takes place, the natural phenomena of inflammation ensue, and again the size and weight of the organ are materially increased, and its position in many instances abnormally altered. This deranged position may be brought about either through the increased weight alone, due to circulatory disturbance, or by adhesions having formed, which draw and fix the organ in its displacement, or by both combined.

3. In many virgins we have displacements of the uterus of all varieties. W. J. Mayo (1) states: "We have complete records of the physical examination of many thousands of women. While the normal position of the uterus in the majority of women, perhaps 75 per cent, is more nearly anterior than posterior, it must be acknowledged that in at least 25 per cent and at various ages retroposition exists. The condition will be found as often in the young girl as during the child-bearing period, and after the menopause, and it is probable that retroposition of the uterus is even more common than these data would suggest." The anterior and especially the retrodisplacement may be brought about in the following manner: At the menstrual period the young woman may be subjected to extreme cold, a severe wetting, or a fright, which may produce a cessation of menstruation when the uterine blood-vessels are full and turgid. This results, as in the causes mentioned before, in an increase in the size and weight of the organ and the local conditions are ripe for a displacement. Owing to the increased size and weight produced by the foregoing causes, one of two things happens. When displacement occurs either the fundus falls forward, producing an increased ante-flexion, or the uterus straightens up owing to the increase in blood pressure, and the vertical axis of the uterus lies in the same plane as the vertical axis of the pelvis, where it is in position to begin descent. Now, if the pelvic fascia and the uterine ligaments are normal, the uterus may undergo involution, and spontaneous recovery ensue. On

[1] Read before the Chicago Gynecological Society. January 16, 1914. (See discussion, p. 778.)

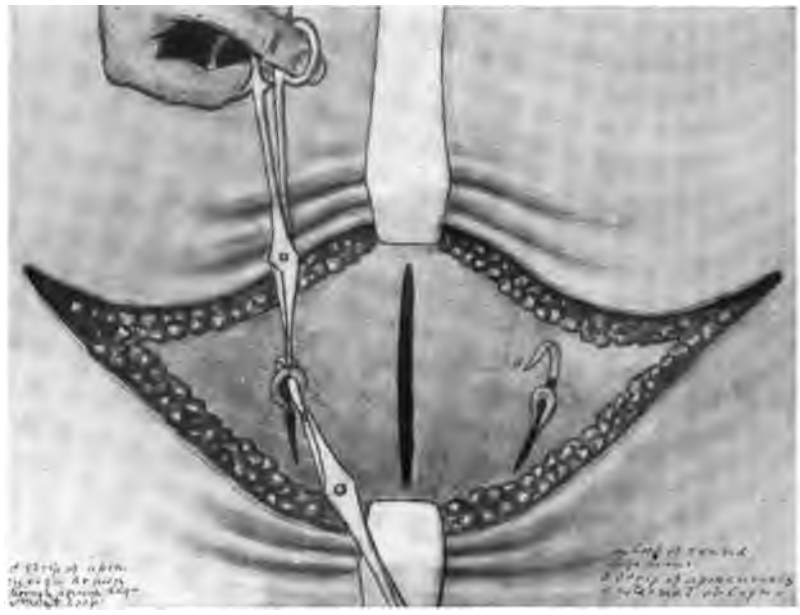


Fig. 1.

the other hand, with relaxed ligaments and fascia, any sudden increase in voluntary muscular effort, or increased intra-abdominal pressure, may push the uterus over into retroversion, or the first step of descent is begun.

Prolapse of the uterus is merely a hernia, and is produced by the same influences which cause herniæ in other parts of the body; viz., relaxed outlets, increased internal pressure, and traumatism.

In addition, Barton Cooke Hirst (2) says: "There are three injuries responsible for prolapse which must be kept in mind. First, the stretching with possible actual lacerations of the fibers of the cardinal ligaments of the uterus in the bases of the broad ligaments supporting the cervix, lower uterine segment, and, indirectly, the vaginal vault. Second, the complex injury of the anterior vaginal wall, consisting in (a) an over-stretching of the longitudinal fibers of the fascial plate derived from the bases of the broad ligaments, extending downward between the bladder and the vagina; (b) a lateral separation of these fibers by the eccentric pressure of the child's head in labor; (c) a glacier-like movement of the vaginal wall on its subjacent attachments, tearing them loose; and (d) a laceration of the muscle and fascia of the urogenital trigonum, the only support of the lower third of the anterior vaginal wall. Third, a laceration of the levator ani muscle in the posterior vaginal sulci with a certain amount of that glacier-like movement of the posterior vaginal wall noted in the anterior wall."

*Symptomatology.* The reasons which cause a woman suffering from displacements of the uterus to consult her physician are many and varied. In marked prolapse the cause is obvious, yet it is astonishing how many women refrain from any consultation even when suffering from a marked degree of prolapse, because they are suffering no pain, but merely are inconvenienced by the uterine protrusion, and the soiling of their linen from discharges of pus and blood—the fear of an operation evidently being paramount. In a larger number of instances, however, the patient complains of a bearing-down pain, and, where the displacement is accompanied by a severe perineal laceration, of a feeling as if "everything were falling out of her."

Pain in the sacral region is prominent; constipation is often a marked symptom, combined with painful defecation; there is not

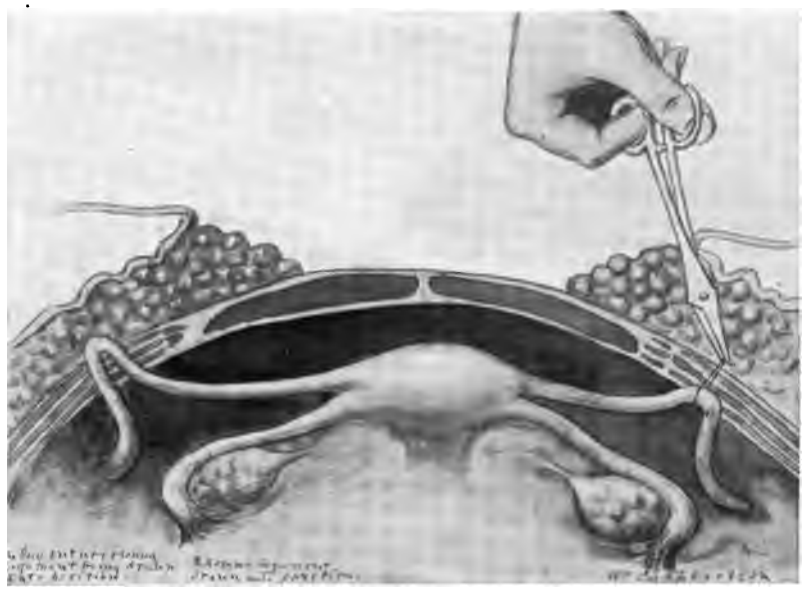


Fig. 2.

infrequently a dysmenorrhœa; amenorrhœa and menorrhagia and metrorrhagia may alternate; while finally, after more or less prolongation of any or all of the above symptoms, a state of neurasthænia may have supervened. On the other hand, there are undoubtedly many cases of uterine displacements of pronounced type (excluding, of course, prolapse) which produce no symptoms whatever. The presence or absence of these symptoms may be explained by Crile's mechanistic theory of disease. In those women who have been subjected to oft-repeated child-bearing, abortion, or who have indulged in excessive coitus, there is produced what Crile terms a "lowered threshold" by repeated stimuli to the afferent nerve tracts; while in virgins, masturbation and unsatisfied sexual longings excite the nerve tracts in a similar manner and the same results obtain. This "lowered threshold" brings the sexual organs of the patient into undue prominence, and hence any unusual disturbance draws her attention to the pathologic condition of the parts and she seeks relief.

*Operation.* I will not attempt to enumerate all the various operations which have been devised for the correction of the uterine displacements, but merely draw attention to some of the more prominent ones. The Alexander operation was one of the most widely used in the correction of these displacements, but it was applicable only to those cases which were free from adhesions and infections and where the uterus could be easily drawn forward. This operation when properly performed was one of the most successful which has been devised and could be utilized either during the child-bearing period or after the menopause.

Next came the ventrofixation and ventrosuspension operations. These were absolutely bad, the first because it fixed the uterus in an abnormal position and could not be used during the child-bearing period on account of its being a prolific cause of abortion, as well as being responsible for many cæsarean sections from the dystocia which it produced. Ventrosuspension was less objectionable as it could be performed at any period of the woman's age. Its defects were, however, that where only one attachment was made to the anterior abdominal wall, the resulting cord was not sufficiently strong to hold the uterus in position, and an elongation took place which allowed the uterus to fall back into its old condition of retroversion or descent. If two attachments were made,

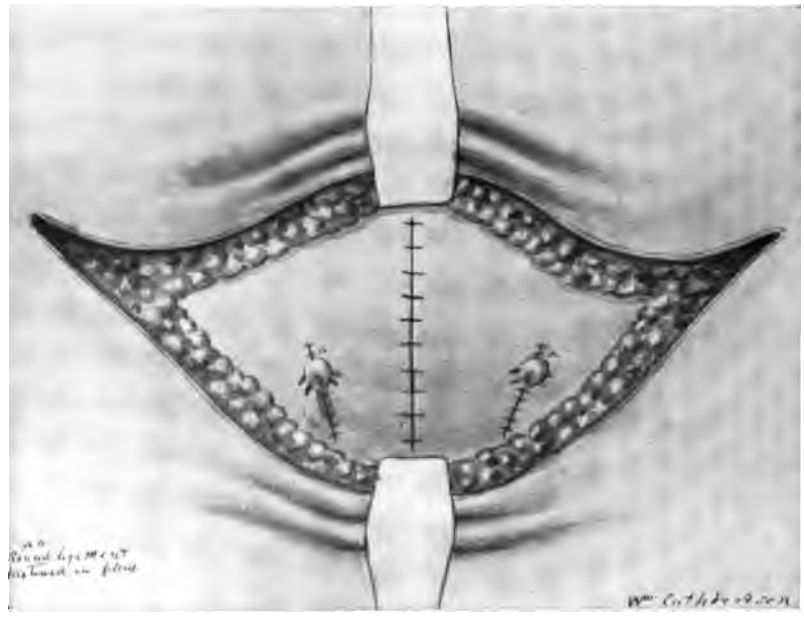


Fig. 3.

intestinal obstruction and strangulation took place in a sufficient number of cases to condemn the operation.

To my mind, any operations which involve the use of the broad ligaments, such as plicating, stitching them to the posterior surface of the uterus, etc., are wrong in mechanical principle, consequently they will not be mentioned. From the number of operations in which it has been utilized, it would seem that the round ligament is the most useful structure by which these displacements can be corrected. Furthermore, the mechanical principle which is involved in its utilization, viz., an upward and forward pull, seems to be the most correct. That upward and forward pull is the greatest when the round ligaments are brought out through the anterior abdominal wall, rather than where they are fixed through vaginal incision, such as in the Watkins-Wertheim operation. One of the earliest and most cogent objections to the anterior abdominal wall operation was that the round ligaments could not be permanently secured in the recti muscles and the fascia. To overcome this the late Alexander Hugh Ferguson and Franklin H. Martin brought the round ligaments across the front of the abdomen either over the aponeurosis or through a tunnel and stitched them together. This pulled the uterus up too close to the anterior wall and also put too great a strain on the ligaments, especially if they were short and poorly developed, and even after this stitching they did not hold in their new position.

H. N. Vineburg (3) fastens the uterus to the anterior wall by two sutures placed around the round ligaments on either side of the uterus which are brought out through the recti muscles and fascia and tied subcutaneously. He claims good results from this operation, although he reports one case of intestinal obstruction following its use. Gilliam's operation (4) in which he brings the round ligaments out through the anterior abdominal wall at the internal ring seems to me to be the nearest to anatomical perfection, in that it produces the least disturbance in position of the round ligaments, leaves no openings for the production of intestinal obstruction, and produces the greatest degree of correct mechanical pull, viz., upwards and forwards, which is necessary to overcome the displacement under consideration. The weak point in his operation, however, is the tran-

sient holding in place of the shortened ligaments, and it is this defect which I have endeavored to overcome and which I have the honor to submit for your favorable consideration.

*Operation.* The first step after the usual preparation of the patient is to make a Pfannenstiel incision from one internal ring to the other, and after loosening the skin upwards and downwards from the subjacent fascia the abdomen is opened in the median line by as small an incision as possible through which necessary manipulations can be made (Fig. 1). All uterine adhesions are broken up, the resulting bare spots are covered over by peritoneum, the uterus replaced in normal position, and the round ligaments on either side caught up by rubber-protected intestinal forceps. This procedure I find necessary because the round ligaments can be easily amputated by bare steel forceps. After the round ligaments are isolated, a point is selected far enough from the uterus which when the ligament is shortened will hold the uterus in its normal position. In selecting this point the size of the ligaments will have to be taken into consideration—the smaller the ligament, the nearer the uterus is the point to be selected. Through this point a catgut guy suture is passed and the round ligaments drawn through the anterior abdominal wall as in the Gilliam operation (Fig. 2). The next step is adapted from the operation of L. L. McArthur where he uses a live aponeurotic suture in the radical cure of hernia.

The aponeurosis of the external oblique is seized with a snub-nosed forceps and with a scalpel, a strip of the aponeurosis is peeled up from just above Poupart's ligament to a point about two cm. above where the round ligament emerges from the muscle. Next, a sharp-pointed pair of Kocher's forceps is pushed through between the two arms of the ligament and, catching the aponeurotic strip, it is drawn down into place again and stitched there with a continuous catgut suture (Fig. 3). Interrupted catgut sutures are placed through the round ligament and fascia to hold the ligament in its new position until the strip of aponeurosis shall have grown into place. By this means the round ligament is permanently prevented from slipping or being pulled back into the abdominal cavity, and the uterus is absolutely held in its normal position.

I have performed this operation fifteen times in the past two years. Twelve of the patients are still under observation in which no recurrence of the displacement has taken place. The other three have been lost sight of. Two of these women have undergone pregnancy and delivery. There was no dystocia in either case. Three of the women had prolapse of the uterus of the second degree, with torn perineum, and three, associated rectocele and cystocele. In these patients plastic operations were done on the vagina.

I have found this operation to be exceedingly valuable in case of a cystocele accompanied by uterine prolapse. After an anterior colporrhaphy is done and the uterus is well drawn up and fixed, the cystocele does not recur.

In my earlier operations I found that where the genito-crural or ilio-inguinal nerves were caught in the suturing, a good deal of pain persisted in the inguinal region. Subsequently I have been careful to avoid these nerves, with the happiest results.

By using the Pfannenstiel incision through the skin and the vertical through the subjacent abdominal wall plenty of room is assured to perform any necessary operations on the uterine adnexa which may be found imperative.

REFERENCES

1. Mayo, W. J. J. Am. M. Ass., 1912, Oct. 19.
2. Hirst, Barton Cooke. Ibid, 1912, March 23.
3. Vineburg, H. N. Surg., Gynec. & Obst., 1911, xii, 378.

# THE EDUCATIONAL VALUE OF CANCER STATISTICS TO INSURANCE COMPANIES, THE PUBLIC, AND THE MEDICAL PROFESSION[1]

By FREDERICK L. HOFFMAN, Newark, New Jersey
Statistician of The Prudential Insurance Company of America

CANCER, in its relation to life insurance, presents itself in a threefold aspect: first, as a problem in selection or insurance medicine; second, as an element in insurance experience; and third, as a question of state medicine, with a special regard to the educational value of cancer statistics and the feasibility of cancer control. The importance of the problem is set forth in the statement that the approximate mortality from cancer in the continental United States for 1913 is about 75,000; and considered by organs or parts affected, the estimated mortality for 1912 was as follows:

ESTIMATED MORTALITY FROM CANCER IN THE CONTINENTAL UNITED STATES, 1912

| | Both Sexes. Deaths. | Per Cent. |
|---|---|---|
| Buccal cavity | 2,768 | 3.9 |
| Stomach and liver | 28,041 | 39.5 |
| Peritoneum, intestines, rectum | 9,371 | 13.2 |
| Female organs of generation | 10,790 | 15.2 |
| Breast | 6,886 | 9.7 |
| Skin | 2,627 | 3.7 |
| Other organs and parts | 10,507 | 14.8 |
| | 70,990 | 100.0 |

For the year 1910 the average age at death in cancer and other malignant tumors combined was 59.2 years for the registration area of the United States. For males the average age at death was 60.4 years, and for females, 58.4 years. Considered by organs or parts affected, the average age at death in cancer of the buccal cavity was 63.1 years; in cancer of the stomach and liver, 61.2 years; in cancer of the peritoneum, intestines, and rectum, 59.2 years; in cancer of the female generative organs, 53.8 years; in cancer of the breast, 58.3 years; in cancer of the skin, 68.0 years; and in cancer of other organs and parts not specified, 56.9 years.

As a problem in insurance medicine, cancer presents unusual difficulties to both the examining physician and the medical director. The literature of the subject extends over half a century, since practically every authority on insurance medicine has given the subject at least incidental consideration. Most of the earlier writers, beginning with Brinton in 1856, emphasize the assumed hereditary character of cancerous affections, but as early as 1857 Ward called attention to the personal aspects of the disease as made evident in "sallowness or pallor of the face, the general clayey hue of the skin, and peculiar sadness of expression." Also, "the anæmic, chlorotic aspect of females suffering from uterine deragement." Allen, who was apparently one of the first American writers on insurance medicine, in his "Medical Examinations for Life Insurance," published in 1866, referred briefly to the subject under the general title of tumors, giving a few directions of value in medical examinations and advising unconditional rejection even in the case of non-malignant tumors as involving danger by their anatomical position or as requiring a severe surgical operation.

These views have continued to prevail among writers on cancer as a problem in medical selection for insurance, and passing over a large number of authors whose conclusions I have been at pains to bring together, I would refer first to the standard treatise by Charles Lyman Greene on "Medical Examination for Life Insurance," published in 1905, in which occurs the statement that "the hereditary nature of cancer is a subject of dispute, but the weight of evidence is strongly in favor of a well-marked hereditary influence." Havilland Hall, in 1906, in the third edition of his "Medical Examination for Life Assurance," writes that "cancer comes next to consumption in regard to frequency of hereditary transmission." Ramsey, in 1908, in his "Practical Life Insurance Examinations," accepts the hereditary theory of cancer occurrence; and Brockbank, in 1908 also, in his work on "Life Insurance

[1] Read before the Clinical Congress of Surgeons of North America, Chicago, November 13, 1913.

and General Practice," concludes that "females show a greater tendency to inherit whatever is the condition which leads to cancer than males do, and they also die from it at a younger age than their brothers would." In a general way, continental authorities have accepted the same view, and their conclusions are apparently sustained by the experience of the Gotha Life Insurance Company, but for a comparatively early period of time.

Few of the writers on insurance medicine have given useful advice on methods of diagnosis to disclose either an existing cancerous condition or a well-pronounced tendency to the disease. The over-emphasis given to the assumed hereditary theory has no doubt been of much harm in that it has prevented a due consideration of the non-hereditary aspects of the disease when considered from a life insurance point of view. It is also quite probable that most of the writers have taken for granted a general conformity on the part of the examining physician to accept and act upon the prevailing theories in medical diagnosis, direct and differential, which, it goes without saying, has made considerable progress during recent years. This conclusion applies not only to cancers in general but particularly to gastric ulcers and their complications, to cancer of the stomach, and, in the case of women, to cancer of the breast. The cancer experience of life insurance companies cannot be fully reviewed on this occasion. The published data are of considerable scientific interest and well deserving of a qualified and thorough analysis. They date back over more than a century and illustrate the advance of medical science as much as they sustain the conclusion that there has been an actual increase in the cancer death rate.

A large amount of statistical information on the subject of cancer is available for American and foreign insurance companies, but the available data can only be very briefly referred to. The experience of the Germania, of Stettin, published in 1897, sustains the Gotha experience as regards the value of medical selection in reducing the mortality from cancer during the earlier years of insurance. Considering the two periods of a duration of five years or less, and six years or more, it appears that the actual mortality of males per 1,000 at ages 31–40 was 0.21 and 0.32, respectively; at ages 41–50 it was 0.67 and 1.14; at ages 51–60 it was 1.97 and 2.87; and at ages 61 and over it was 4.63 and 6.64. The results for females are about the same. The cancer death rate for males was 1.33 per 1,000; and for females, 1.90. The experience covers the period 1857–94. It may be stated in this connection that for women only the death rate from cancer during the period 1857–82 was 1.38 per 1,000, whereas for the entire period, 1857–94, it was 1.90. There had, therefore, been a not inconsiderable increase in the cancer mortality during the later years, but to be entirely conclusive, the experience should have been extended to insurance durations and divisional periods of life.

In the experience of the Austrian Phœnix, the proportionate mortality from cancer has increased from 8.5 per cent during the five years ending with 1906, to 10.4 per cent during the five years ending with 1912. In the experience of the Riunione Adriatica di Sicurta, of Triest, the proportionate mortality from cancer has increased from 9.3 per cent during the seven years ending with 1905 to 8.0 per cent during the seven years ending with 1912. In the experience of the Leipziger, which is one of the largest German life insurance companies, the percentage of deaths from cancer has increased from 11.8 during the ten years ending with 1902, to 12.6 per cent during the ten years ending with 1912. In the experience of a large Hungarian company, however,— the Fonciére,— the proportionate mortality from cancer has slowly declined from 8.6 per cent during the five years ending with 1905, to 8.0 per cent during the five years ending with 1911. In the experience of the Assicurazioni Generali, the largest Austrian company, the proportionate mortality from cancer was 9.2 per cent during 1899–1905, against 9.5 per cent during 1906–12. The experience of many other foreign companies could have been quoted to sustain the conclusion that in most cases the proportionate mortality from cancer has increased

during recent years, and that in any event the mortality from malignant disease is of more importance to life insurance companies than has generally been assumed to be the case.

The most recent American investigations tend to confirm this point of view. In 1903, the combined experience of thirty-four American life insurance companies was published by the Actuarial Society of America. It was brought out with reference to persons who had a family history of cancer that the subsequent experience had been very good with young entrants, almost equally good with mature entrants, fairly good with elderly entrants, but not good with old entrants, but the actual number of the latter was hardly sufficient for a final adverse conclusion.

The most recent investigation is for the period 1885–1908. The number of deaths of males at ages 15–29 was 4,566, of which 95 were from cancer and other malignant tumors, or 2.1 per cent. The mortality rate was 1.0 per 10,000 at ages 30–44; the total number of deaths was 7,886, of which 377 were from cancer, or 4.8 per cent of the mortality from all causes, or 3.2 per 10,000 exposed to risk. At ages 45 and over there were 5,340 deaths, of which 411 were from cancer, or 7.7 per cent of the mortality from all causes, or 14.4 per 10,000 exposed to risk.

The same experience has been made up regarding women applicants. At ages 15–29 the number of deaths from all causes among insured women was 3,696, of which 98, or 2.7 per cent, were deaths from cancer, or 1.4 per 10,000 exposed to risk. At ages 30–44 there were 5,661 deaths from all causes, of which 668, or 11.8 per cent, were deaths from cancer, equivalent to a rate of 7.3 per 10,000 exposed to risk. At ages 45 and over there were 4,917 deaths from all causes, of which 654, or 13.3 per cent were deaths from cancer, or 24.3 per 10,000 exposed to risk.

The medico-actuarial investigation considered also the relation of build at entry to causes of death, with distinction of three divisional periods of life. Dividing the applicants into three classes,— that is, overweights, or those whose weight at entry was 50 lbs. and more; and standard lives, or those who were of normal weight; and underweights who weighed 25 lbs. or more below the standard,— the experience with reference to cancer was as follows: at ages 15–29 the cancer death rate of overweights was 0.9 per 10,000, and of underweights, 0.8. At ages 30–44 the cancer mortality of overweights was 3.7 per 10,000, and of underweights, 2.4. At ages 45 and over the cancer mortality of overweights was 15.6, and of underweights 12.0 per 10,000 exposed to risk. The experience, therefore, conclusively sustains the view occasionally expressed by writers on the subject of cancer occurrence, that the disease is more common among persons of overweight than among underweights, and, by inference, among the well-to-do and over-nourished, than among the less prosperous element but of more normal physique. The medico-acturial evidence is of exceptional value in that it confirms this conclusion for three periods of life on the basis of what may safely be considered to have been a sufficient exposure.

Some very interesting facts regarding cancer as disclosed by the experience of a large and representative life insurance company were first exhibited by The Prudential Insurance Company of America in connection with an exhibit made at the Louisiana Purchase Exposition in 1904. The information has been brought down to date for the present purpose, and the results seem to sustain the conclusion that the proportionate mortality from cancer is distinctly less among industrial risks, representative of the wage-earning element, and distinctly higher among ordinary risks, regardless of a more rigid medical examination, but representative of the more prosperous and well-to-do. Considering only the age period 40–59, it appears that for males the proportionate mortality from cancer in the company's ordinary experience was 6.7 per cent against 5.10 per cent in the industrial experience. For females, the corresponding proportions were 18.5 per cent in the ordinary experience, and 13.7 per cent in the industrial. Throughout, the proportionate mortality from cancer was very much higher among insured women than among insured men. Selecting, for illustration, the age period 50–54, it appears that in the industrial experience of The Prudential

the proportion of deaths from cancer at this period of life was 5.76 per cent for males, against 15.31 per cent for females. In the ordinary experience the corresponding proportions were 8.1 per cent for males and 18.3 per cent for females. It is quite probable that the value of medical selection, with particular reference to cancer, is distinctly less in the case of insured women than of insured men; but in view of the facts disclosed by the medico-actuarial investigation, that there is a distinct value in the medical selection with reference to cancer as shown by the reduced mortality from this disease during the early years of policy duration, it would seem entirely safe to conclude that the proportionate mortality from cancer is distinctly higher among the prosperous and well-to-do than among the wage-earning element, including the less prosperous and the poor.

The foregoing observations and conclusions touch only the fringe of a vast problem of the greatest possible importance to the public: the life insurance companies, which are engaged in the business of assuming risks conditioned by the duration of life, and the medical and surgical profession, but for whose combined efforts and relatively high degree of professional efficiency the mortality from malignant disease would be much greater than is actually the case. The time has come for concerted action in the direction of educating the public at large in the earliest possible symptoms of even pre-cancerous conditions, or predisposing states of the tissues, on the one hand, and the efficacy of the earliest possible operative treatment, on the other. The public requires to be made familiar with the accepted facts of surgical experience, which, for illustration, in the case of operations for cancer of the breast show a reduction in the primary mortality, from 25 per cent in pre-antiseptic days to less than 1 per cent at the present time; and a further reduction, according to Deaver, in the probability of local recurrence from 65.6 per cent to only 6.5 per cent. The initial symptoms require to be treated on the part of the public with more seriousness than is usually the case, and also the advisability of the earliest possible qualified medical and surgical treatment as an essential prerequisite for the obtaining of a cure, or at least a material prolongation of life. It is far better to overrate the seriousness of even apparently non-malignant tumors than to underrate the terrible possibilities of ultimate changes or degeneration from benign into malignant tumors. Even the occurrence of warts and pigmented moles requires to be looked upon as a possibly pre-cancerous condition, and certainly every lump in the breast, or continuous local pain, should suggest the possibility of malignant disease. In the case of cancer of the uterus there can no longer be a question of doubt but that permanently successful results are obtained by the earliest possible operative treatment, but that even a comparatively short delay is frequently followed by fatal results. The many excellent suggestions which have been advanced by Winter, of Koenigsburg, and those who have followed his teachings, are bound, in the course of time, to result in a material reduction in the now excessive mortality from this most terrible affliction. The mortality from practically all other forms of cancer can be reduced by operative treatment provided, on the one hand, the cases are brought early to the attention of qualified surgeons, and, on the other, that medical practitioners improve in methods of diagnosis, and with all the power at their command urge against fatuous reliance upon other than surgical methods of ultimate treatment.

As a further step in qualified and practical cancer research, the experience of American surgeons and American hospitals should be brought together in a convenient form and subjected to critical analysis, for the purpose of disclosing the lessons of the actual experience and the changes and results under past and present methods of operative treatment. The literature of cancer is now so enormous that it defies the understanding of any one mind in even a single specialized direction, chiefly on account of the want of really trustworthy data on any and all important phases of the cancer problem in its relation to the medical and surgical profession, the life insurance companies, the public, and the State. It would, therefore, seem eminently proper and fitting for the Clinical Congress

of Surgeons of North America to initiate a rigid collective inquiry into the facts of American surgical experience, with regard to the immediate and after-effects of surgical operations for malignant and non-malignant tumors, with a due regard, of course, to the numerous details, such as age and sex, previous duration, physical condition at the time of operation, methods of treatment, and after-care. A vast amount of information exists but is practically unavailable to the public at large and to most of the practicing physicians and surgeons out of contact with the large medical libraries of large cities. There are the strongest possible reasons for believing, however, that if the cancer facts, including medical and surgical experience, were brought together in an authoritative form, they would not only materially aid the work of the American Society for the Control of Cancer, but the various cancer research funds, as well as the individual practitioner in his relations to the patients and the public at large. With this end in view, however, it is necessary that there should be intelligent and active coöperation between the laity and the profession, on the one hand; and the life insurance companies, and the federal and state governments, on the other. If, by means of such coöperation, the present upward tendency of the cancer death rate is only halted, and if, by indefatigable efforts, even a slight reduction in the rate from any or several forms of cancerous affections is brought about, the results will be well worth while, and the work done will be a genuine contribution to the well-being of civilized mankind.

---

# DEATH OF A FULL-TERM FŒTUS DUE TO CONSTRICTION OF THE UMBILICAL CORD BY AMNIOTIC BANDS; RUPTURE OF AMNION; HYDRAMNIOS[1]

By EUGENE CARY, S. B., M. D., Chicago

THE existence of amniotic bands during prenatal life was described as early as 1812. Medical literature is full of such cases. These bands give rise to many pathological conditions of the fœtus such as malformations, intra-uterine amputations and constriction of the umbilical cord. It is not, however, the purpose of this article to consider this subject in all its ramifications, but rather to concentrate upon a consideration of amniotic bands which constrict the umbilical cord and cause the death of the fœtus.

Much has been written as to the origin of these bands. In 1830, Montgomery advanced the theory that these bands were formed by organized lymph. Later, Simpson of Edinburgh, Simonart, Virchow, and others believed their origin to be due to an inflammatory process. In 1854, C. Braun first voiced the opinion that these so-called Simonart's bands originated from an abnormal folding-in of the membrane due to an insufficient quantity of amniotic fluid during early embryonic life. Küstner, in an article written in 1889, upholds this same view.

Lvoff believes these bands to be due to some faulty development of the amnion and that the bands begin as a folding of the membrane, but it is his belief that this folding occurs when the embryo first separates from the amnion. He states further that at first these bands lie close to the amniotic sac and cause no danger to the fœtus, but as the amniotic sac enlarges they stretch, and lie free in the fluid. Thus movements behind them on the part of the fœtus may entangle some member, or even the cord, causing malformations, malnutrition, or death.

Another etiological factor in the origin of these bands was put forward about 1890, by Küstner, Olshausen, and others. They believed that rupture of the amnion led to the formation of broad bands that later became adherent to the fœtus. Küstner describes a

[1]Read before the Chicago Gynecological Society, January 16, 1914. (See discussion, p. 776.)

case of congential amputation of the hands and feet by amniotic bands. These he thinks resulted from a ruptured amnion due to the mother's lifting a heavy load in the second month of pregnancy. In this case the amnion had entwined itself about the cord, but had not compressed it enough to cut off fœtal circulation.

Rupture of the amnion alone during the first half of pregnancy has been reported in a considerable number of cases. Stoechel, in 1905, says: "The amnion is a firm, resistant membrane, but it alone (as opposed to the chorion) may rupture during the early months of pregnancy." Of this condition he cites twelve cases collected by v. Myer-Runge (Braun, Olshausen, Bar, 2; Maygrier, Lebedeff, Osmont de Caseu, Crouzat et Payrari, Maroger, Myer-Runge, each one case). He has also observed that after the amnion has ruptured it quickly retracts and shrinks down into a little rolled-up pouch which surrounds the insertion of the cord into the placenta like a cuff. In May-Grier's case, bands from the ruptured amnion had caused spontaneous amputations of the fingers and toes and encircling bands were bound around the cord itself. In another case the constriction of the cord was so great that the death of the fœtus resulted.

Stoechel asks: "Did these bands originate after rupture of the amnion, as Olshausen believes, or were they present before the rupture as Simonart's threads?" It is my belief that the rupture of the amnion had a great deal to do with the formation of bands in these cases, especially if two or more rents occurred before shrinkage took place, and it seems more than a mere coincidence that they should have occurred in nearly every case in which the amnion had ruptured prematurely.

In all the cases of rupture of the amnion before term that were collected, the rupture occurred during the first half of gestation with the exception of one case reported by G. Braun of Vienna, in 1865. Braun is indefinite as to just how near term the rupture occurred, but states that eight days before delivery fœtal movements and fœtal heart tones were plainly discernible. After delivery the amnion was found freshly torn and the cord constricted by a band of this torn amnion looped about it.

This brings us to a consideration of the case which I have to report:

Mrs. X., a two-para, 32 years old, entered St. Luke's Hospital September 18th at 9:30 P. M., in the first stage of labor, the membranes having ruptured just prior to her entrance.

She is American born and has been married six years. She has one child and has never had a miscarriage. Her menses began at fourteen years of age and since then have been of the regular twenty-eight-day type. Her first pregnancy and puerperium was normal; her previous history negative.

The date of her last menstrual period was December 21, 1912, and she felt "life" May 10, 1913. During the pregnancy urinalysis disclosed a trace of albumin and a few hyaline casts with a rather low specific gravity (1.006) at two different periods, all of which readily cleared up under treatment.

During the latter months of pregnancy she developed a condition of hydramnios. Aside from

Fig. 1.

the above conditions the pregnancy was uneventful until two days before the onset of labor, when she was disturbed by "excessive kicking of the baby." After this unusual demonstration of "life" the fœtal movements, as far as she could tell, ceased. This occurred September 16th, and was not reported at the time.

Labor pains began September 18th at 8 P. M., just after rupture of the membranes. The patient immediately went to the hospital for confinement. On examination, the head was found in the left occipito-anterior position, but neither fœtal heart tones nor fœtal movements could be detected.

Labor progressed normally, and September 19th at 9:30 A. M. the patient was delivered of a slightly macerated female fœtus, 57 cm. long, weighing 3,344.3 grams. Thirty minutes later the placenta was delivered spontaneously. The cord was centrally implanted. The chorionic membrane was intact, but there was only a short fringe of the amniotic membrane about 10 cm. long left around the insertion of the cord into the placenta. The remaining portion of the amnion was wrapped about the cord 22 cm. from the fœtus (Fig. 1).

The puerperium was uneventful.

The cord is of about the average length (52 cm.), but thicker than normal. There

is considerably more Wharton's jelly than is usually found and the cord has the feel of being waterlogged. About 25 cm. from the umbilicus is a constriction composed of two firm bands of tissue that have knotted together. These bands or small ropes are composed of shredded amniotic membrane rolled up to be very resistant to considerable strain. They can, however, be readily unrolled.

The constriction of the cord is so firm that not only is all the circulation shut off, but even the Wharton's jelly in that region is also pushed aside.

In this case it is seen that the amnion was ruptured and was represented only by a fringe around the placental insertion of the cord. To substantiate the statement that it is a recent rupture and not one occurring early in pregnancy, we find that the fringe is not retracted or shrunken, that there are no adhesions between it and the fœtus, that there are no malformations of the fœtus, and lastly, that the chorion is not thickened and is not firmly adherent to the lining of the uterus. I say that the chorion is not thickened or adherent because, in cases reported by Lebedeff, where the amniotic membrane is absent, there is an inflamation of the chorion which he attributes to the presence of the excretory products of the fœtus.

The main issue of my case is, of course, the condition that directly caused the death of the fœtus. The cause was constriction of the cord, cutting off fœtal circulation by two bands of recently torn amniotic membrane. In this case the amnion undoubtedly ruptured under the strain put upon it by the condition present, namely hydramnios. After the tear had occurred the amniotic fluid dissected the amnion from the chorion, and allowed the former to float free in the sac. The movements of the fœtus soon tore this into shreds which rolled up to form membranous ropes in the form of loops around the child, the fixed end of the loop necessarily being at the insertion of the cord into the placenta. From the findings, it seems probable that the whole free, floating portion of the amnion was twisted into two such ropes which happened to cross where they both passed by the umbilical cord. In this way the movements of the fœtus managed to tie a knot in the bands around the cord. The fact that both ends of these bands were anchored made every movement of the fœtus draw the knot firmer, and as partial asphyxia set in, the movements becoming more violent and, the ropes holding, the cord was totally constricted and death of the fœtus resulted from asphyxia.

It is interesting to note that in the literature on this subject I have been unable to find a single case cited where *hydramnios* had caused a late rupture of the amnion, which in turn constricted the cord and so caused the death of the fœtus. Friedrich Ahlfeld, however, says: "Any case of hydramnios predisposes to pathological conditions of the mother or child." Chiari says: "Viewed from the standpoint of pathological anatomy, it is not impossible that malformations and even death of the fœtus may result from an abnormally spacious amnion, or from a premature collection of amniotic fluid. Yet actual observations have not been made to substantiate this opinion." As regards this statement it is interesting to note, in passing, that Ahlfeld reports a case of club-foot occurring in a fœtus where a condition of hydramnios was present complicating a twin pregnancy. Burstal found four deformities in 133 cases of hydramnios, but no adhesions.

I should like to quote fully the following case by Lvoff, reported in 1898, which has not yet been translated from the Russian. It is a case in which death of the fœtus was caused by constriction of the cord on account of being caught in the loop of an amniotic band, but in his case the amnion was intact. His case was as follows:

"I was called on a case on account of malposition, VI-para. Pregnancy was normal with labor at term. Fœtus was alive during pregnancy and fœtal movements were obtained two hours after labor began, when they ceased.

"Examination revealed the fœtus lying in the transverse position; membranes not ruptured but bulging. Fœtus lay high up and no heart tones could be heard.

"Version was hastily performed. The sac was ruptured near the placental margin, releasing meconium stained water. The child was born dead and its color was cyanotic.

"The cord was of the average length with no irregularities. In looking for the cause of death in the placenta and membranes it was found that death was caused by a tightly drawn loop formed of an amniotic thread, constricting the cord at a distance of one-third its length from the fœtus.

"This amniotic band originated at the insertion of the cord into the placenta from which point it extended parallel to the cord, free through the amniotic fluid, to where it looped around the cord. From here it passed, free again, to its attachment on the lining of the amniotic sac, where was the rent through which the version had been done. The amnion was found to be intact, normally developed and everywhere adherent to the chorion."

In conclusion I wish to thank Dr. I. J. Franklin for the necessary aid he gave me in translating Lvoff's article from the Russian. In fact, it was really the first reference I found that shed any light at all on the work in hand.

From a careful review of all the literature on this subject I could find, I was able to obtain only one case that is similar to mine, and that is reported by C. Braun. In his case the amnion ruptured late and shreds of this ruptured membrane constricted the cord and caused death eight days before the onset of labor. Lvoff's case was somewhat similar, as the cord was constricted by an amniotic band, but the etiological factor was altogether different, for in Lvoff's case the amnion did not rupture.

The rupture of the amnion was undoubtedly due to over-distention from the condition of hydramnios present, and thus another possible complication may be added as a result of this condition of over-distention.

A sudden increase in the activity of the fœtus in the latter part of pregnancy should lead one to suspect compression of the cord from some cause threatening the life of the fœtus. This fact is emphasized by Jones in a case in which circulation was cut off by looping of the funis around the legs of the fœtus two months before term.

## BIBLIOGRAPHY

1. Ahlfeld, Friedrich. Berichte u. Arbeiten aus der Geburtshilf. Gynäcol. Klinik zu Giessen, 1881–1882.
2. Braun, C. Oesterreich Z. f. pract. Heilkunde, 1865, No. 9–10.
3. Braun, G. Über spontane Amputationen des Fœtus und ihre Beziehungen zu den amniotischen Bändern. Ztschr. d. Gesellsch. d. Ärzten, Wien, 1854.
4. Brauns, H. Intra-uterine Gliederblösung u. Zerreissung des Amnion durch amniotischer Faden. Rostick, 1894.
5. Chiari, H. Relation of Amnion to the Origin of Human Malformations. Johns Hopkins Hosp. Bul., 1911, p. 36.
6. Gratzer. Die Krankheiten des Fœtus. Breslau, 1837.
7. Jones. Fœtal Death from Looping of the Cord. J. Am. M. Ass., 1905, xlv, 242.
8. Küstner. Amniotische Bänder und Strange. Müller's Handbuch d. Geburtsh., 1889.
9. Küstner. Über eine noch nicht bekannte entstehungsweise amputirender amniotischer Faden und Strange. Ztschr. f. Geburtsh. u. Gynäk., 1890.
10. Lvoff, I. M. Twisting of a Cord by Amniotic Threads as a Cause for Death of Fœtus and Abortion. Vrach, 1881, No. 28.
11. Lvoff, I. M. On Amniotic Threads Constricting Cord. J. Akush. i. Jensk., St. Petersb., 1896, x, 230.
12. Lebedeff, A. I. Ann. de Gynecol., 1878, apr.
13. Montgomery. Dublin, J. for M. and S., 130.
14. Runge, M. Geburtshilfe., 1905, p. 1460.
15. Simonart. Amputations Spontanies. J. D. Conn. Med. Prat., Bruxelles, 1846.
16. Simpson. Edinburgh M. and S. J., 1836.
17. Stoechel. Anomalien der Eihaut. v. Winkel's Handbuch d. Geburtsh., 1905, p. 1450.
18. Virchow. Die Siamesischen Zwillinge., Berlin. klin. Wchnschr., 1870.
19. Burstal, E. 133 Cases of Hydramnios. The Practitioner, 1910, July, 112.

# CLINICAL AND EXPERIMENTAL RESULTS OF STREPTOCOCCIC INFECTIONS WITH SPECIAL REFERENCE TO ARTHRITIS AND ITS TREATMENT[1]

By FREDERICK G. DYAS, M. D., Chicago
From the Pathological Laboratory of St. Luke's Hospital

THE purpose of this paper is to discuss certain clinical and experimental data associated with streptococcic infections, with special reference to their localization in joints and their treatment.

Streptococcic infections with the clinical manifestations of septicæmia originating from a puerperal infection, a post-mortem wound, or by inoculation of an abrasion of the skin or mucosa, have been recognized for a long time. However, the so-called cryptogenetic and epidemic forms have been less thoroughly studied. I believe the term "cryptogenetic" should be abandoned, inasmuch as it is highly probable that some microscopic lesion of the skin or mucosa is the atrium of infection when no gross change is found.

Streptococci may reach the blood through tonsils showing little or no pathologic change, on superficial examination. It is a significant fact, however, that cultures and smears taken from the surface of tonsils may bear no relation to the organisms recovered from the crypts or cut surfaces of the same organs.[1]

Escherish has noted in children enteritis following the ingestion of milk infected with streptococci and in this manner the body invaded by the germs. It is also possible that streptococci entering the gastro-intestinal canal with milk or food may pass through the normal tissues of the bowel into the lymphatics and then via the thoracic duct into the blood, as it has been shown experimentally that tubercle bacilli fed to dogs reach the blood-current through the same route. Abrasions or operative wounds of the upper respiratory passages or oral cavity permit direct inoculation of the blood or lymphatics.

Acute and chronic lesions of the joints, heart, and kidneys are frequently associated with streptococcic throat infections. In a series of 28 cases of chronic arthritis associated with tonsillitis, Davis recovered hæmolytic streptococci from the crypts of the tonsils and there was reason to believe that these organisms were causally related to the joint lesions. These streptococci readily produced arthritis in rabbits, when given intravenously, and Dr. Jackson in a paper recently published explains the localization of these experimental streptococcic infections in the joints upon anatomic grounds. It would appear from her results that the organism through an embolic process in the minute subsynovial capillaries invades early the joint cavities directly. Endocarditis, as well as arthritis, was also produced by the streptococci in a number of instances.

As bearing upon this subject I may refer to some clinical data which have come under my personal observation, viz.:

Mrs. L. had had repeated attacks of acute tonsillitis and arthritis finally terminating in endocarditis. The tonsils were removed during the illness, as they were greatly hypertrophied and showed acute inflammation. Cultures and smears from the surface of the tonsils showed only pneumococci and staphylococci, while cultures and smears from the cut surface and crypts showed pure growths of streptococci. Injection of a large rabbit intraperitoneally with a 24-hour culture suspended in salt solution caused death of the animal in 24 hours. Intravenous injections of this organism were not made.

Mr. J. in February, 1912, submitted to a submucous resection of a deflected nasal septum. Considerable hæmorrhage occurred and the nares were tightly packed with gauze. One week later the patient had a severe rigor with temperature of 102° and rapid pulse. The packing was removed from the nares, permitting the escape of a considerable quantity of a dirty dark fluid. On the following day the right knee became red, tender, and swollen, and movements of the joint were exquisitely painful. On the succeeding days there was continued elevation of temperature, rapid pulse, drenching sweats and successive involvement of the larger joints, so that almost any movement was impossible. Marked atrophy of the muscles occurred, especially of the interossei. A systolic murmur at the base of the heart appeared one week after the initial chill.

[1] Wruslow: Bull. Johns Hopkins Hosp.
Hamburger: J. Infect. Dis.
Miller and Capps: J. Am. M. Ass.
D. J. Davis.

[1] Read before the Chicago Surgical Society, February 6, 1914. (See discussion, p. 774).

Cultures made from the blood were negative, but the streptococcus was found in pure culture in the throat. Acute suppurative otitis media occurred early in the disease. Paracentesis relieved the symptoms and permitted a free discharge of pus. At the end of the second week a massive generalized furunculosis occurred. The furuncles contained staphylococci and cleared up with vaccine treatment.

Partial recovery, with deformities of most of the large joints associated with limitation of motion and muscular atrophy, followed. As a result of the endocarditis, a mitral incompetency exists at present. Medication, in this case including the use of antistreptococcic serum and phylacogen, was of no avail. The disease apparently ran a self-limited course. No injections or aspirations of the joints were undertaken nor was extension by means of a weight and pulley made.

These two cases serve to illustrate how infection with the streptococcus may take place both through the nasal mucosa and through the tonsils. The marked wasting of the muscles in this case is a striking illustration of the rapid muscular degeneration both of the striped and unstriped tissues as a result of the absorption of toxic material.

Many methods have been advanced for the treatment of acute joint infections. These may be briefly classified as follows:

(*a*) Local. 1. Medical treatment: This includes rest of the affected joint, application of heat or cold, application of drugs or poultices, and bandaging. 2. Surgical treatment: This embraces, immobilization of the part by casts or splints, Bier's hyperæmia, aspiration of the fluid content of the joint cavity and injection of drugs, extension by weight and pulley, incision and drainage, and irrigation.

(*b*) General treatment consists of the administration of various drugs, sera, and vaccines.

Spitzer [1] endorses the use of Bier's hyperæmia, compression, and the use of hot air in the treatment of all forms of infectious arthritis whether polyarticular or monarticular. Inasmuch as drug and mechanical treatments are notoriously uncertain and the antistreptococcic serum is more often a failure than a success, he believes that the ultimate successful treatment will be by means of a polyvalent serum.

[1] Spitzer, Neuere Behandlungs formen des akuten Gelenk Rheumatismus. Med. Klin., Berl., 1909, v, 1668.

Mendel [2] and numerous others have used subcutaneous injections in acute infective arthritis. Jackson [3] used intra-articular injections of a solution of magnesium sulphate in acute arthritis without good results.

Porter [4] has discontinued the use of intra-articular injections of formalin in olive oil or iodoform emulsion in chronic joint infections and reports good results with their use only when the arthritis is acute and confined to the synovial membrane. Murphy strongly endorses the use of two per cent formalin in glycerin in all forms of joint infections and extends the application to infections of the pleura.

This solution of formalin appears to cause no serious results even when injected intravenously in a quantity as high as 10 ccm. Three years ago the writer injected a series of dogs of various sizes intravenously with varying amounts of this solution and was never able to observe any harmful effects upon the animals.

Capps and Lewis [5] found intrapleural injections of two per cent formalin in glycerin in dogs rapidly fatal when injected into an empyema which had been produced experimentally.

As a result of the above mentioned cases together with several other streptococcic infections, it was decided to investigate the matter from the experimental side with a view of determining the effect of the injection of certain substances into and about the joints of animals. Therefore a number of rabbits were inoculated intravenously, with 24-hour cultures of arthritis-producing streptococci suspended in normal salt solution. The strain of streptococcus used was recovered from the crypts of tonsils removed from a patient suffering with chronic infective arthritis.

A medium-sized rabbit was used. The joints of both legs on the right side (elbow, wrist, knee, ankle) were injected with a solution of two per cent formalin in glycerin. Simultaneously an intravenous injection of

[2] Mendel, Salicylates in Rheumatism, Therap. Monatschr., 1904, iv.

[3] Jackson, Injection Magnesium Sulphate for Acute Articular Rheumatism. N. Y. M. J., 1911, xciii, 1223.

[4] Porter, John L., Surg., Gynec., & Obst. 1913, March.

[5] Capps & Lewis, Arch.

two 24-hour blood-agar cultures of a strain of an arthritis-producing streptococcus was made. The animal died in forty hours.

Post-mortem examination showed the joints swollen and containing turbid fluid. Cultures made from all joints, both those previously injected with formalin solution and those not injected, showed luxuriant growths of streptococci. Cultures from the heart's blood also showed streptococci. The most marked pathologic change occurred in those joints which had previously been injected with formalin-glycerin solution. The explanation of this finding seems to lie in the fact that the intensely irritating formalin primarily devitalized the delicate synovial membrane to such an extent that it was less able to resist infection than when in normal condition.

A number of other rabbits were treated in the same manner; viz., by the intravenous injection of 10 ccm. of a 24-hour culture of streptococci suspended in normal salt solution. Simultaneously certain of the large joints were injected with a solution of two per cent formalin in glycerin and a record kept of the joints so treated. In each animal swelling and stiffness of the joints developed in from 24 to 72 hours, together with symptoms of severe intoxication. The rabbits appeared to be sick, refused to eat, and lost weight perceptibly. In some cases after a few days there appeared to be an improvement in the general condition, which proved to be only temporary, all the animals finally dying of septicæmia.

Clinically, the swelling and stiffness in the formalin-injected joints were uniformly most marked and this corresponded with the more advanced pathologic changes found post-mortem in the joints treated with formalin solution.

Both cultures and smears showed the presence of streptococci in each of the formalin-injected joints, as well as in the joints not so treated. In some of the inoculated rabbits, vegetations were found on the valvular endocardium.

Another series of rabbits was treated by the intravenous injection of 10 ccm. of a 24-hour culture of streptococci suspended in normal salt solution, and at the same time several of the larger joints were injected with a ten per cent emulsion of iodoform; these joints were marked with a solution of eosin for the purpose of identification.

October 26, 1912, Animal No. 6. A medium-sized rabbit was injected with a 24-hour culture of streptococci suspended in normal salt solution. The left knee and ankle joints were injected with ten per cent. emulsion of iodoform in glycerin. Eight hours later joint involvement was most pronounced in the joints injected with iodoform emulsion. The rabbit appeared sick and moved with difficulty and died on the fifth day. Post-mortem examination revealed a multiple suppurative arthritis, most marked in injected joints. Heart's blood showed streptococci in pure culture.

October 30, 1912, Animal No. 7. A medium-sized brown rabbit was injected intravenously with 2 ccm. of a 24-hour culture of streptococci. No joint involvement followed. Three days later another injection of 4 ccm. of a 24-hour culture of streptococci suspended in salt solution was made. Forty-eight hours later a marked stiffness in the joints occurred, but no swelling. The rabbit moved slowly and with pain. An intravenous injection of 3 ccm. of a 25 per cent solution of sodium salicylate was administered. The following day a marked improvement in stiffness was noted, but after 48 hours the stiffness became again pronounced.

A reinjection of 1 gm. of 25 per cent sodium salicylate intravenously. The rabbit grew progressively weaker, developing swellings about the larger joints, with the exception of one leg, and died two weeks after inoculation. Post-mortem examination showed pus in large quantities in the larger joints, in one of which it infiltrated the muscles. The heart showed no changes. Smears and cultures from pus in the joints showed streptococci. Cultures from the heart's blood also yielded streptococci.[1]

Our results in this series of animals were uniformly similar to those obtained in the animals injected with formalin solution. The

[1] It seems evident that the intravenous injection of a 25 per cent sodium salicylate solution, given either once or repeatedly, has no influence upon the general course of the infection.

clinical and post-mortem findings were most exaggerated in the joints injected with the iodoform emulsion as compared with the joints not so treated.

Pure cultures of streptococci were recovered from each of the joints previously injected with iodoform emulsion, as well as from the joints not so treated.

As it was evident from the results obtained in the formalin- and iodoform-injected joints that neither of these substances protected the joint against the streptococcic infection, it was decided to attempt to protect the entire animal by intravenous injections of a solution of sodium salicylate in water at the time of the intravenous inoculation of the streptococcus.

In a careful search of the literature no record could be found of the intravenous injection of sodium solution. However, solutions of sodium salicylate in from 10 to 20 per cent strength have been given clinically by the subcutaneous method. To obtain any results, several injections must be made daily, thus necessitating the use of cocaine or of some other local anæsthetic, a procedure which, however, is exceedingly painful and prone to produce localized abscesses. The tendency to furunculosis in patients suffering from acute articular rheumatism, as a result of the drenching sweats, is well known, hence the liability to abscess formation would be all the greater, if repeated injections of salicylate solutions were given. Mendel reports favorable results following the injection of an 18 per cent sodium salicylate solution into chronic rheumatic joints.

The following experiments were, therefore, undertaken with the idea of determining the influence of intravenous injections of sodium salicylate upon rabbits inoculated intravenously with arthritis-producing streptococci.

A medium-sized rabbit was injected intravenously with a 24-hour culture of streptococci suspended in salt solution. Simultaneously an intravenous injection of 1 gm. of a 25 per cent aqueous solution of sodium salicylate was made. At the same time, as a control experiment, a medium-sized black rabbit was given a similar injection of streptococci, but without the injection of the solution of sodium salicylate. Two days later a marked stiffness was noted in the black rabbit, which had not received the sodium salicylate injection, while the white one appeared much more active and was reinjected with 1 gm. of a 25 per cent solution of sodium salicylate intravenously. One week later both animals developed multiple pus infections in their joints and died. Cultures and smears from the joints showed streptococci.

In the rabbits used in the above experiments no rigors were noticed. The animals frequently appeared sick and apathetic after 12 hours. Movement of the legs was painful and the animals crouched down in their cages with their joints flexed. In from 24 to 36 hours, in many cases, painful, fluctuating swellings of the larger joints were observed and these swellings persisted until death. Unlike the clinical picture of acute articular rheumatism, there was not the fugitive involvement of the joints but rather a more or less simultaneous attack on all the larger joints, and none of the joints so attacked showed any tendency to heal. No bony ankylosis occurred, but, as the animals died in so short a time, it is impossible to say whether ankylosis might not have occurred later.

All the animals became rapidly emaciated and presented the appearance of a severe acute intoxication, and, although some of them lived as long as two weeks, all finally died of a streptococcic septicæmia.

Davis has been able to regulate the dose in such a manner that he has succeeded in producing multiple suppurative arthritis without causing the death of the animal. In his series of animals many of the articular lesions subsided and the animals recovered without any clinical evidence of permanent changes in the joints, while in others the arthritis became chronic, causing destruction of the articular surfaces of the bones and the periarticular soft tissues. In four of his animals joint changes occurred simulating arthritis deformans, but after several months the enlargement entirely subsided.

## SUMMARY

1. In each animal multiple suppurative arthritis developed in from 24 to 72 hours,

depending upon the amount of streptococci injected, and this occurred regardless of whether attempts had been made to protect certain joints by injections of different solutions, or to protect the entire animal by intravenous injections of sodium salicylate.

2. Swelling and stiffness of the larger joints were noticed after 24 to 48 hours in all cases.

3. Post-mortem, thick purulent material was found in the joints which could be scraped away leaving the synovial membrane dull and lusterless.

4. Destruction of articular surfaces of bones, ligaments, and cartilages may occur when the animals do not succumb too early to streptococcic septicæmia.

5. Cultures from the heart's blood and from the pus from joints in the animals used gave pure cultures of streptococci.

6. The greatest pathologic changes occurred in those joints in which attempts had been made to protect them by injections of formalin or iodoform.

7. Intravenous or intra-articular injections of sodium salicylate in solutions as strong as 25 per cent have no permanent effect upon streptococcic arthritis.

8. Intra-articular injections of solutions of formalin in glycerin or iodoform emulsion do not protect the joints so treated.

9. Aspiration of the pus and injection of antiseptic solutions after infection of a joint had taken place did not give favorable results in the animals injected intravenously with streptococci.

## BIBLIOGRAPHY


JACKSON. Injection of Magnesium Sulphate for Acute Articular Rheumatism, N. Y. M. J., 1911, xciii, 1223.

SEIBERT. Hypodermic Injections of Sodium Salicylate in Rheumatism, Med. Rec., 1911, lxxix, 432.

MENDEL. Salicylates in Rheumatism, Therap. Monatschr. 1904, iv.

JONES. Report of a Case of Acute Articular Rheumatism following Diphtheria Cured by Use of Autogenous Vaccine, N. Orl. M. & S. J., 1910, lxiii, 411–414.

COOMBS. Changes in Tissues which follow Rheumatic Infection, St. Mary's Hosp. Gaz., Lond., 1910, xvi, 121.

ANDERSON. Etiology of Acute Rheumatism and its Affinities, Austral. M. J., 1911, 145.

ROSENTHAL. Bactériologie, Sérothèrapie et Vaccination du rheumatisme articulaire aign, Arch. gen. de Méd., Par., 1909, 571.

WOOLEY. Etiology and Pathology of Acute Articular Rheumatism, Western Med. Rev., 1909, xiv, 490.

GALLAVARDIN AND DELANCHANAL. Contribution à l'étude des localistions du rheumatisme articulaire aign sur le tissu conjunctif sour-cutane, du phlegmon serum rheumatismal, Lyon méd., 1909, cxiii, 813.

ROSENTHAL. La Sérothèrapie du rheumatisme articulaire aign, J. de Méd., Par., 1909, 2. S. xxi, 453.

SPITZER. Neuere Behandlungeformen des akutem Gelenkrheumatismus, Med. Klin., Berl., 1909, v, 1668.

GHOSH. The Local Injection of Sodium Salicylate in Acute Rheumatism, Brit. M. J., 1910, i, 690.

THOMPSON. Rheumatism and Infection of Joints, Memphis Med. Month., 1910, xxx, 293.

BEATTIE. Further Experiments with a Streptococcus Isolated from Cases of Acute Rheumatism, J. Pathol. & Bacteriol., 1909–10, xiv, 432–435.

MOSLER AND VALENTINE. Pathologie des akuten Gelenkrheumatismus, Berl. klin. Wchnschr., 1910, xlvii, 1778.

STEINERT. Akute und chronische Streptokokkensepsis und ihre Beziehungen zum akuten Gelenkrheumatismus, München Med. Wchnschr., 1910, lvii, 1927.

PORTER. Treatment of Tuberculous Joints, Surg., Gynec. & Obst., Mar., 1913, p. 334.

# THE RÖNTGEN FINDINGS IN GASTRIC AND DUODENAL ULCER[1]

By JAMES T. CASE, M. D., Battle Creek, Michigan
Röntgenologist to the Battle Creek (Michigan) Sanitarium and to St. Luke's Hospital, Chicago; Attending Röntgenologist to Cook County Hospital, Chicago; Lecturer on Röntgenology, Northwestern University Medical School, Chicago

IN attempting to summarize our present knowledge of the X-ray method in studying gastric and duodenal ulcers, I recognize that new facts are being developed daily in this newest of the accessory means of clinical study of the alimentary tract. The present-day scarcity of textbooks in röntgenology is easily explained when one considers the rapid advances being made from year to year and even from month to month. This is especially true in relation to the gastro-intestinal tract. This field of röntgenologic study still remains, in a large measure, virgin soil. There must yet be large series of cases studied by the röntgen ray and checked up rigidly by the findings of the surgeon and the pathologist.

Gastro-intestinal röntgenology is in its infancy and needs all the help to be derived from other departments of clinical research. The child's mistakes do not negative his potential worth as a man. An attitude of helpful and friendly critical suggestions will surely serve best in considering the value of this means of clinical study.

The röntgen evidences of ulcer of the stomach and duodenum may be classified under the following heads:

1. Bismuth flecks representing ulcer craters filled with bismuth.
2. Filling defects in the stomach shadow.
3. Organic deformities of the stomach other than filling defects. These various phenomena constitute what may be called the *definite* X-ray evidences of ulcer.

Under the head of *inferential* evidence may be classified:

4. Spastic manifestations.
5. Abnormalities of peristaltic waves.
6. Abnormal emptying time of the stomach.
7. Unusual filling of the duodenum.
8. Pressure pain points.

These evidences will be considered in the order named.

*Bismuth flecks representing ulcer craters filled with bismuth.* The first suggestion with relation to gastric ulcer heard from one unfamiliar with X-ray examinations of the alimentary tract is that the crater of the ulcer should accumulate bismuth and thus cast a shadow visible on the screen or röntgenogram. In other words, it is the popular idea that the ulcer itself should show. As a matter of fact, however, experience has shown that it is rare indeed for an ulcer to show in this manner. Aside from the penetrating ulcers at about the middle of the lesser curvature, I have had only eight or ten proven cases (by operation) in which the crater filled with bismuth; and several of these were so near perforation that after exposing the stomach and before proceeding to the necessary surgical procedure, the surgeon felt obliged to reënforce the tissues at the site of the ulcer to prevent possible rupture during manipulation. Aside from these penetrating ulcers on the lesser curvature, and ulcers of the duodenum, I have encountered only four cases where the bismuth fleck in the stomach corresponded to a gastric ulcer.

Penetrating ulcers of the lesser curvature, the X-ray findings in which were first described by Haudek, will be considered under another head.

Flecks in the duodenum representing flecks in the crater of an ulcer may be confused with a number of shadows, as, for instance, bismuth flecks in the ampulla of Vater. This bismuth fleck is not easily demonstrated as being in the ampulla unless one manages to fill the duodenum at the same time the ampulla is made to show. I have a few such cases. Dr. L. G. Cole has also called attention to this source of error. Other confusing shadows which may be mistaken for the ulcer crater filled with bismuth are right renal calculi, small gall-stones and bismuth residues in the gall-bladder following cholecystenterostomy. I know of at least one case in which bismuth was found in the

[1] Read by invitation before the Chicago Surgical Society, December 5, 1913. (See discussion, p. 771.)

gall-bladder following spontaneous cholecystenterostomy. Normally, a small portion of bismuth persists in the first portion of the duodenum, the duodenal bulb, for some time after the stomach is completely emptied.

*Filling defects in the stomach shadow.* Defective filling of the stomach with the resulting defective shadow is most characteristic of carcinomatous invasion of the stomach, but it may also be seen in connection with inflammatory masses attending gastric ulcer. Defects in the duodenal bulb constitute one of the chief röntgenographic means of recognition of duodenal ulcer and its complications.

Filling defects on the lesser curvature are to be differentiated from carcinoma and rarely from syphilis and tuberculosis. I do not know of any way to differentiate from the X-ray findings alone between the defect caused by a small carcinoma and that caused by a callous ulcer (Fig. 11). The surgeon himself is sometimes unable to differentiate when he has the lesion between his fingers.

I am able to report and show the slides of a case of tuberculous ulceration of the stomach. This ulcer occurred on the greater curvature at the junction of the middle and lower thirds, measuring about two and a half inches by an inch and a half.

Instead of producing a filling defect, lesser curvature ulcers, as a matter of fact, may produce a projection from the stomach shadow. The size of the projection may vary from the scarcely discernible nodule upon the stomach shadow to a typical penetrating ulcer of the type described röntgenologically by Haudek.

Defects in the shadow of the duodenal bulb are rather common. Their discovery by means of the röntgen ray has been popularized by Cole in this country and later by George and Gerber. According to Moynihan, 95 per cent of duodenal ulcers occur in the first part of the duodenum, the so-called bulbus duodeni. The normal shadow of the duodenal bulb has been carefully studied by Cole and others and slight variations from the normal are easily recognized. Abnormal shadows of the duodenal bulb, the so-called "pilleus ventriculi" of Cole, may result from penetration or perforation of a chronic ulcer, cicatricial contraction, stenosis, pressure upon the duodenal bulb of extra-duodenal tumors, adhesions resulting from gall-bladder or pancreatic disease. Occasionally sacculations of the duodenal bulb may be demonstrated. Filling defects in the duodenal shadow, to be interpreted as ulcer, should be differentiated from the normal defects due to the hepaticoduodenal ligament and the deformities of the bulb due to extraduodenal pressure, as, for instance, gall-bladder, blood-vessels, second portion of the duodenum, etc. The defects due to gall-bladder region adhesions are very characteristic; the defect occurs on the gall-bladder side of the duodenal bulb shadow, but the bulb is otherwise anatomically normal.

Complete or nearly complete absence of the duodenal bulb is frequently seen in duodenal ulcer with extensive periduodenal adhesions, in carcinoma of the pancreas with extensive adhesions of the duodenum, and more frequently in pyloric or juxtapyloric ulcer with stenosis. In these cases the stomach presents an appearance to which the term "prognathian" has been applied by Cole, the dilatation of the stomach occurring mostly in the pyloric portion and presenting a very characteristic appearance.

George quotes Moynihan as stating that "a duodenal ulcer which has been the cause of protracted and recurrent symptoms is always visible from the outside of the intestine, is always palpable and, therefore, is always demonstrable," and adds to this the statement that there can be no exceptions.

While I place considerable dependence upon the deformity of the bismuth shadow in the demonstration of duodenal lesions, I am not content to rest the case upon this evidence alone. Other evidences, such as hyperperistalsis, hypertonicity, hypermotility, or early pyloric insufficiency with later pyloric spasm and delayed emptying, are some of the other signs that ought to be demonstrated in duodenal ulcer.

*Organic deformities of the stomach other than filling defects.* Under this head I especially wish to discuss the organic hour-glass deformities and the sacculation of the stomach often attending penetrating ulcer on the lesser curvature. As above stated, aside from cases of penetrating ulcer, one rarely finds a bis-

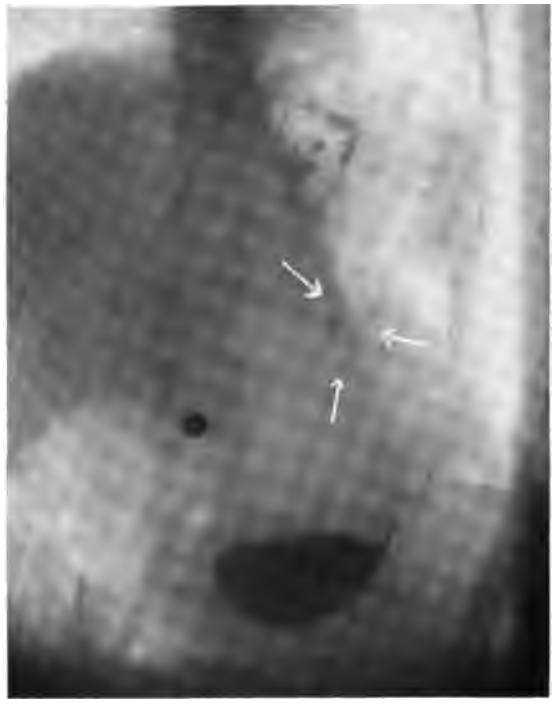


Fig. 1. Bismuth fleck (at arrows) seen six hours after a bismuth meal, marking the crater of an ulcer near penetration.

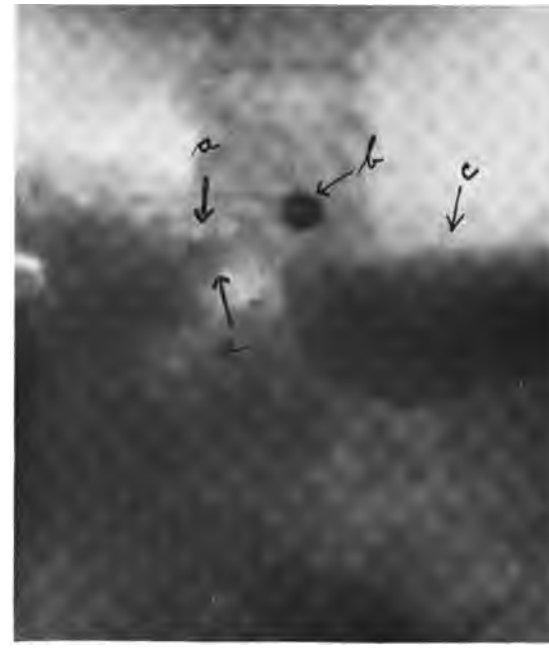



Fig. 2. Bismuth residue six hours after a meal in a case of penetrating ulcer of the duodenum; (a) bismuth fleck in crater of ulcer; (b) navel marker; (c) six-hour residue. Röntgenogram made with patient standing.

muth fleck which can be proven to be a bismuth accumulation in the crater of an ulcer. Penetrating ulcers on the lesser curvature frequently produce characteristic deformities which are röntgenographically demonstrable, according to the extent of penetration. The projecting bismuth shadow may vary from a small outcropping from the stomach shadow, scarcely discernible on the screen, to a large bismuth mass ten or fifteen centimeters in length and half as wide. Whether the projecting bismuth shadow or diverticulum has formed posteriorly in connection with adhesions and fixation to the pancreas, or anteriorly with adhesions to the liver, is easily observed by careful screen examination, turning the patient this way and that until by proper oblique illumination the location and extent of the perforation may be determined. The projecting shadow will be found to move up and down during respiration when the perforation is anterior in connection with the liver, but it will be immovable during respiration when the perforation and fixation have occurred in relation to the pancreas.

Perigastric adhesions distorting the stomach and interfering with gastric peristalsis are likely to occur, and are responsible, in part, for the hour-glass appearance often seen in these cases. This hour-glass deformity is usually partly spastic and partly organic — the spasm being due to gastric ulcer, the organic changes being due to the perigastric adhesions. These adhesions frequently fix the stomach and often extensively involve the neighboring organs. Many times the inflammatory mass attending perforated ulcer may be definitely felt and when palpated under the fluorescent screen examination may be definitely identified as belonging to the stomach shadow. In the typical penetrating ulcer, Haudek, Faulhaber, and others have described above the projecting bismuth shadow a small collection of gas which has the same relation to the small diverticulum as the "magenblase" or stomach bubble has to the stomach itself. This small collection

Fig. 3. Röntgenogram made twenty-eight hours after a bismuth meal showing a bismuth residue in the gall-bladder region, proven to be bismuth in the gall-bladder, having passed through the cholecystenterostomy opening.

of gas lying above the localized bismuth shadow in connection with the ulcer has, in fact, been termed the "little magenblase."

The presence of this extra shadow with a tumor mass having an evident connection with the stomach speaks for ulcer rather than carcinoma, especially when there is no encroachment upon the shadow of the stomach with the resulting filling defect characteristic of carcinoma. When the patient is examined in the erect position, it is frequently possible to demonstrate above the localized addition to the gastric shadow, the superimposed air bubble above described, which definitely marks the case as one of penetrating ulcer of the stomach.

The hour-glass formation, partly organic and partly spastic, frequently associated with ulcer on the lesser curvature, differs from the appearance seen in carcinomatous hour-glass stomach. In differentiating the ulcer from the carcinomatous condition, it may be stated that in hour-glass stomach due to ulcer there is frequently a residue of the bismuth meal after the sixth hour; the stoma between the upper and lower sacs lies along the lesser curvature, the outline of the greater curvature being drawn over toward the lesser; the narrowing occurs at one distinct point, and the canal is usually short. On the other hand, in carcinomatous hour-glass stomach, the narrow channel connecting the two sacs lies in the stomach axis and is much longer, and there is usually pyloric insufficiency.

Dilatation of the stomach of varying grades is a frequent finding in chronic gastric and duodenal ulcer. The so-called prognathian dilatation associated with stenosing pyloric ulcer has already been referred to. Marked gastric stasis without dilatation is suggestive of a malignant obstruction.

*Spastic manifestations.* A spastic indrawing on the greater curvature producing a sharply outlined localized indentation of the gastric wall, according to the early writers, was evidence of ulcer. It was at first stated that this spasm of the circular muscles of the stomach, which were in reality a deep tonic

Fig. 4. Bismuth-filled stomach and duodenum, the entire duodenum showing. The arrows point to a bismuth fleck seen within the curve of the duodenum. Repeated observation seemed to prove conclusively that this was bismuth in the ampulla of Vater. (Röntgenogram kindly loaned by Dr. L. G. Cole.)

constriction, was characteristic of lesions of the mucous membrane at the level of any given muscular ring. It was discovered, however, that these spastic disturbances were sometimes purely functional. At any rate, in many cases there was no discernible ulcer to be found. It was early admitted that these spastic indrawings might be seen in tabes and hysteria, as well as in gastric ulcer located on the lesser curvature at the level of the spastic indentation.

I reported before the Michigan State Medical Society, Surgical Section, 1913, sixteen operated cases in which such a spastic indrawing on the lesser curvature was proved by operation to be associated with well marked duodenal ulcer, no gastric ulcer being found at the level of the indrawing. In many of the cases, especially those in which gastro-enterostomy was done without clamps, the inside of the stomach was explored and no ulcer could be found. Among the other conditions in which this sign has been noted by the writer, and where anatomical proof has been afforded of the absence of ulcer on the lesser curvature at the level of the indrawing, have been a number of cases of gall-stones, carcinoma near the pylorus, appendicitis, and Grave's disease. Recently I have observed this sign in two cases of paralysis agitans. In fact, it seems that this spastic indrawing is a localized, especially deep tonic constriction of the stomach, the result of vagus irritation, and may be produced by any lesion which causes vagus irritation. The spasm is often overcome by the administration of atropine and it frequently fails to appear with the patient standing. With the patient lying, tension on the gastric walls being relaxed, the spasm occurs very characteristically. When it is due to ulcer on the lesser curvature there is usually a point of pain on pressure coinciding with the lesser curvature at the level of the spasm, and there is no special tenderness on pressure over the duodenal region. When the spasm is due to a duodenal lesion (gall-stones or duodenal ulcer) there is no pain on pressure over the lesser curvature at the level of the spastic indrawing, but there is usually pain on pressure under the

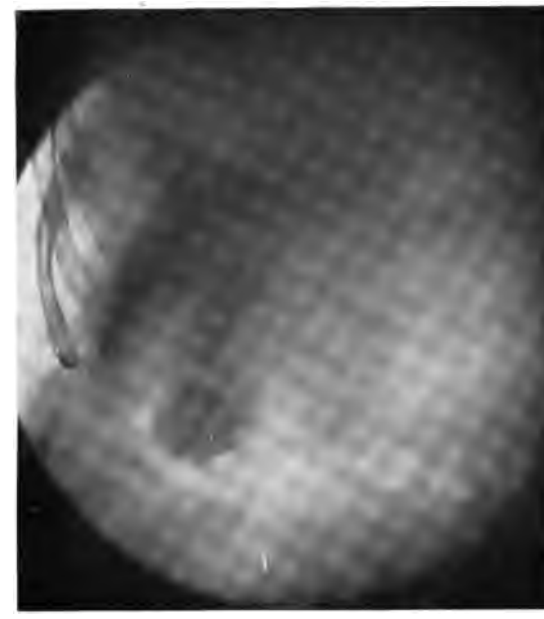


Fig. 6. A large collection of gall-stones found in a case diagnosed clinically as duodenal ulcer.

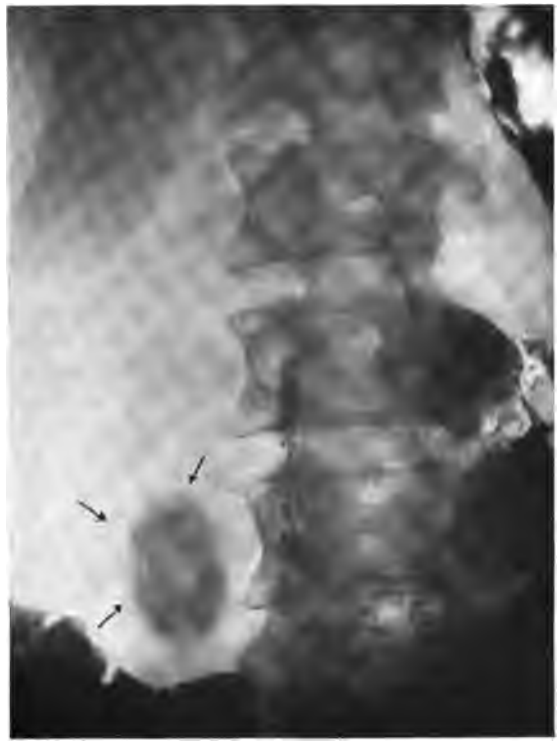


Fig. 5. A single laminated gall-stone found in a case of suspected duodenal ulcer.

Fig. 7. Case of hepatofixation due to adhesions attending gall-bladder disease. Two gall-stones seen to be present.

Fig. 8. Hepatofixation due to adhesions between the duodenum and gall-bladder. No gall-stones seen.

right costal margin, and manipulation of the pyloric or duodenal shadow is often seen to increase the depth of the spastic indrawing high up on the greater curvature. On screen examination, peristaltic waves are often seen beginning above this spastic manifestation and pass it without causing it to disappear. The persisting spastic indrawing on the greater curvature has also been observed in cases of carcinoma on the lesser curvature in the antral portion of the stomach, but the carcinomatous deformity may be differentiated by watching the peristaltic waves. When this indrawing is present with the patient standing, it is found to be extremely marked with the patient lying. On the other hand, this deformity often occurs with the patient lying supine when it is not seen at all with the patient standing. Sometimes these spasms are transient, being seen one day and not another. If the patient is under the influence of any spasm-relaxing drug, such as atropine, this spastic manifestation may be absent.

Of course, at operation these spastic manifestations are rarely seen. An hour-glass constriction which almost bisects the stomach in connection with a penetrating ulcer on the lesser curvature may be almost absent when the anæsthetized patient's abdomen is opened at operation.

*Abnormalities of peristaltic waves.* There is a certain variation in depth and frequency of the normal peristaltic waves, according to the tone of the stomach. When the depth of the peristaltic waves is increased and when they appear more frequently than the normal, the inference is that there is some obstruction at the gastric outlet. In pyloric obstruction, there is frequently observed a sort of systole and diastole similar to that which is claimed by Cole to occur in the normal stomach. Peristaltic waves may at one moment be practically absent and at other times so strong as to almost cut the stomach in two. It seems that this may represent fatigue and periods of revived activity after recuperation from fatigue. Hyperperistalsis and hypertonicity are both suggestive of duodenal ulcer.

Antiperistaltic waves, first described by Jonas, are pathognomonic of an organic lesion

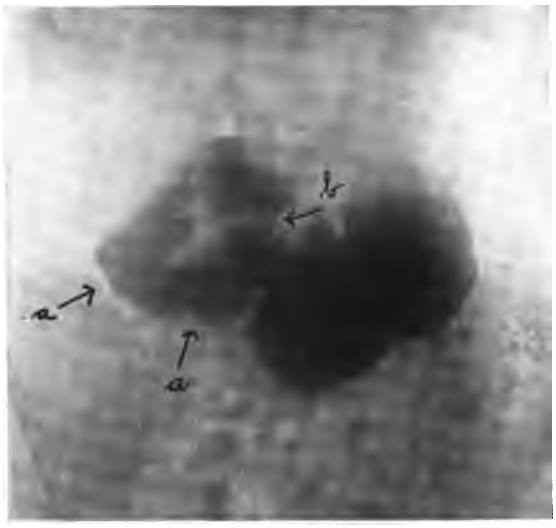



Fig. 9. Case of duodenal obstruction due to adhesions attending an ulcer on the lesser curvature just proximal to the pylorus.

Fig. 11. Deformity on lesser curvature corresponding to a callous ulcer.

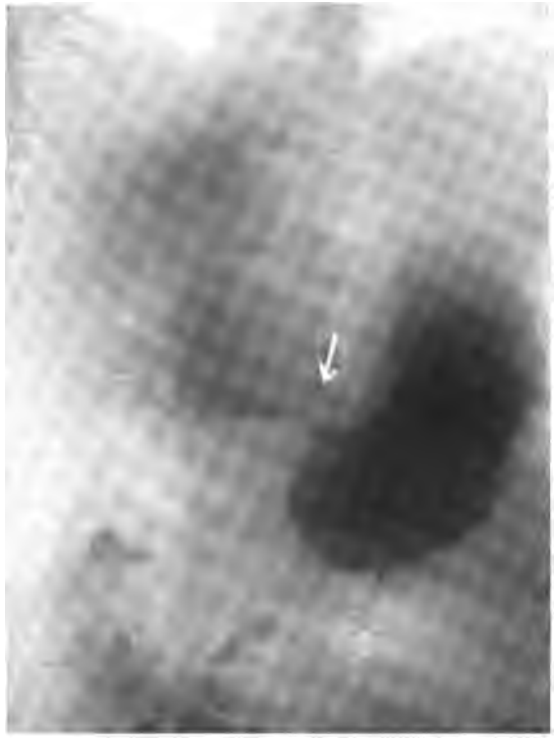


Fig. 10. Deformity of the stomach due to ulcer on the lesser curvature two inches from the pylorus. Ulcer shown at arrow.

Fig. 12. Lateral röntgenogram of the stomach showing deformity of the posterior wall due to ulcer with attending cicatrix.

Fig. 13. Filling defect on the greater curvature, due to a large tuberculous ulcer.

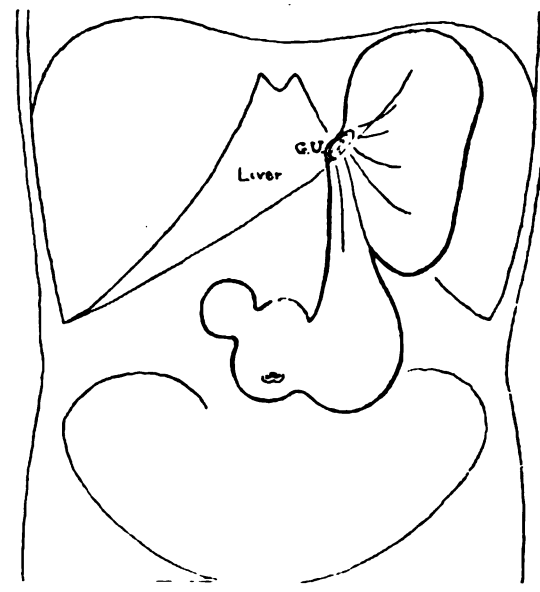



Fig. 14. Drawing (after Hertz) illustrating the deformity of the gastric shadow due to ulcer on the lesser curvature, which has become adherent to the liver.

near the pylorus and frequently point to ulcer. This organic lesion does not necessarily obstruct the pylorus. Antiperistalsis occurs with comparative rarity. I have seen about fifteen cases. Hertz stated as recently as last year that he had never seen it. This phenomenon is best studied when the patient is lying supine. Naturally such study must be made fluoroscopically.

*Abnormal emptying time of the stomach.* Six hours is the period which experience has suggested as the limit of the emptying of the normal stomach following the Rieder test meal, which consists of ten or twelve ounces of farina mush into which two ounces of bismuth oxychloride or subcarbonate have been stirred. The oxychloride is preferable to the subnitrate or subcarbonate. Neither one is necessary, since barium sulphate, a much cheaper substitute, can be very satisfactorily employed. Groedel and others have called attention to the fact that the use of barium sulphate shortens the emptying time of the stomach. The stomach in normal cases usually empties within three or four hours.

The residue at the end of six hours may vary greatly from a small trace to practically all the stomach contents. In some cases, bismuth has been found in the stomach 125 or 150 hours following the bismuth meal. In these cases of prolonged stasis, the residue may become scarcely discernible because of the fact that the newly arriving food from each meal dilutes the bismuth contents of the stomach so that the proportion of bismuth is less from meal to meal.

Although Haudek claims that there can be no ulcer without spasm of the pylorus with a residue at the end of six hours, and that he has never seen a case where the emptying time was longer than six hours without serious alteration of the stomach wall, this claim is contrary to the experience of surgeons and many other röntgenologists. Recently Smithies has reported a hundred cases of gastric ulcer without delay in the emptying time. Many surgeons, basing their indication for operation upon the statement of Haudek, have been disappointed in finding no evidence of anatomical ulcer of the stomach where a six-hour residue has been demonstrated following a bismuth meal.

Fig. 15. Characteristic hour-glass deformity due to a penetrating ulcer on the lesser curvature, such as is illustrated in Fig. 14.

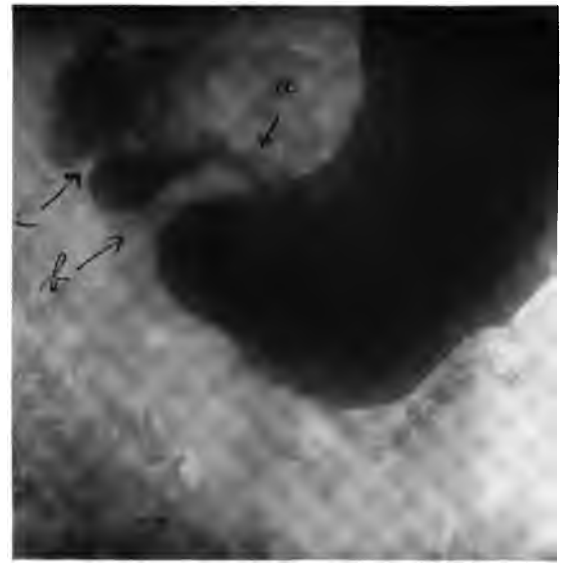



Fig. 17. Spastic indrawing (b) on greater curvature opposite ulcer on the lesser curvature. Normal pylorus shown at (c).

Fig. 16. Spastic indrawing (a) on the greater curvature, formerly considered pathognomonic of ulcer at the corresponding level on the lesser curvature; (b) represents a peristaltic wave which began above the spastic indrawing and fluoroscopically was seen to progress pyloruswards without disturbing the indrawing. It is now recognized that this spastic manifestation is not pathognomonic of gastric ulcer.

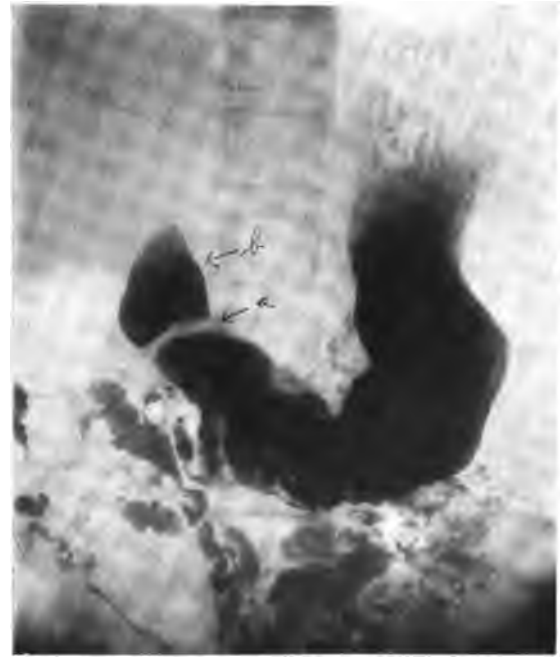



Fig. 18. Normal stomach and duodenal bulb. Pylorus at (a), bulbus duodeni or first portion of the duodenum at (b). This bulb, well filled out, should be demonstrable in every normal case.

Fig. 19. Characteristic deformity of the duodenal bulb in a case of well-marked duodenal ulcer.

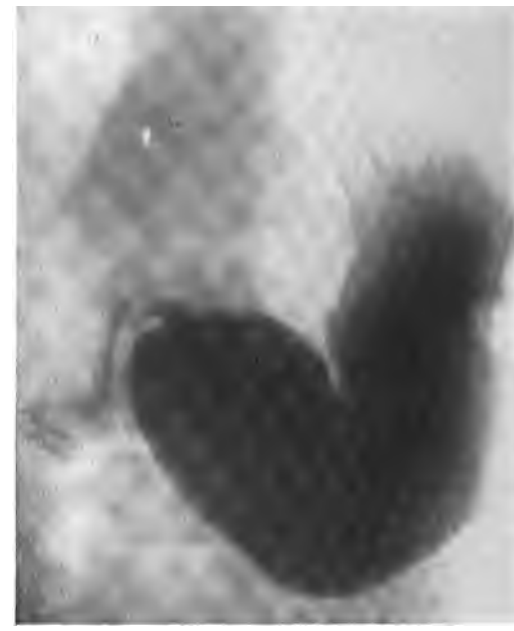


Fig. 20. Almost complete absence of the duodenal bulb in a case of perforating duodenal ulcer with considerable callous formation.

Early clearance of the stomach, when not due to achylia, may be found in cases of gall-bladder disease (with or without stone) and in pancreatic disease when adhesions to the duodenum are present, and in cases of duodenal ulcer. Cases of early malignant induration of the walls of the pylorus, rendering the pyloric sphincter inelastic, are not rare. In pyloric ulcer, with or without actual obstruction, there is delay in the emptying. Gastric ulcer (not pyloric) is not necessarily associated with delayed emptying. It must be admitted, however, that in many gastric and duodenal ulcers, the emptying time of the stomach, after a bismuth meal, is perfectly normal.

In duodenal ulcer it is a frequent observation that the stomach begins to empty at once and at a very rapid rate, bismuth being seen throughout the small intestine within a very short time. If the meal has not been a large one, the stomach may be entirely empty within an hour. When the meal is larger, delayed pylorospasm may be set up, and a small residue remaining longer than six hours may result. Duodenal ulcer cases which do not exhibit this quick emptying, at least during the first hour of digestion, are those where actual mechanical obstruction exists, as by cicatricial contraction. The above behavior of the stomach may be explained, perhaps, as indicating that when the meal is a large one the delay is due to the development of a tardy pylorospasm associated with a delayed hypersecretion.

In pyloric ulcer, on the other hand, suggestive findings are delayed motility with hypersecretion and *early* pylorospasm. As above stated, ulcer in the body of the stomach is not necessarily associated with an abnormal motility.

*Unusual filling of the duodenum.* The normal duodenal bulb has already been considered. This first portion of the duodenum normally shows as a symmetrical, smooth shadow, which has been called the "cap" or "pilleus ventriculi." The shadow is smooth by reason of the fact that there are no valvulæ conniventes in this portion of the duodenum. The bulb is not always well seen immediately after the ingestion of the bismuth meal, but it is usually well seen in the second hour of digestion.

The second and third portions of the duodenum are rarely well seen under normal con-

ditions. But in duodenal obstruction, duodenal ulcer, achylia, and gall-bladder disease the duodenum is frequently seen in its entirety. Unusually marked filling of the entire duodenum is frequently seen in cases of duodenal ulcer, and it is due not so much to a lag in the emptying of the duodenum as to unusual promptness in emptying of the stomach.

*Pressure pain points.* A definite pressure pain point corresponding to the position of the duodenum is often noted during the fluoroscopic examination. The pain point is often seen to definitely coincide with the shadow of the duodenum. It is not, however, pathognomonic of duodenal ulcer. The writer has often seen it in connection with periduodenal adhesions without any evidence (even at operation) of duodenal ulcer. There have been a number of cases, however, in which, in spite of tenderness over the duodenal and gall-bladder shadow, nothing could be found wrong with either of these organs. The writer is satisfied that there is considerable value, however, in palpation over the gastric shadow to localize the points of pain on pressure, but this pressure pain point is not likely to correspond to the location of the ulcer, unless there has been periduodenal or perigastric involvement with adhesions.

In the foregoing paragraphs I have only attempted to summarize and correlate the X-ray evidences which contribute to the diagnosis of gastric or duodenal ulcer. I would like to go on record as stating that in the present stage of development we are not justified in believing that the röntgen method of gastric examination constitutes a reliable method of detecting early gastric or duodenal ulcer. Nevertheless, I believe that in general it is true that surgical lesions of the stomach or duodenum cannot exist without some of the foregoing signs being present. I wish to state that I have seen a few well-marked gastric and duodenal ulcers at operation or autopsy where, during the X-ray examination, there was nothing found either fluoroscopically or röntgenographically which could be considered as suggestive of anything but the normal. It is an astonishing thing how often the bismuth meal will reveal most astounding conditions when they are least expected, and, on the other hand, it may be repeated, very often the X-ray findings are quite the ordinary, even in cases of gastric or duodenal ulcer, when from the clinical study of the case it was expected that the X-ray evidence would be especially characteristic.

# DEPARTMENT OF TECHNIQUE

## TREATMENT OF FRACTURES BY MEDULLARY BONE SPLINTS[1]

By CHARLES DAVISON, M. D., Chicago
Professor Surgery, University of Illinois; Attending Surgeon, University Hospital and Cook County Hospita

THE teaching of Mr. Lane has made the open operation for the treatment of simple fractures very popular and successful. The accurate reduction and stable fixation of fractured bones by metal plates fastened by screws is attractive. But the metal plates and screws are foreign bodies and their presence is more or less resented by the tissues.

In a small portion of the cases plated, the material inserted causes symptoms requiring removal as a foreign body. If the foreign body proposition could be eliminated from the open treatment of simple fractures it would be a distinct advantage towards good end-results.

When a simple fracture is held in fair position by external splints, one of the early efforts of nature to remedy the defect is the production of an internal callus, or medullary plug—a plug of new bone-making material, placed in the medulla across the point of fracture.

This plug ossifies and aids in the repair and support of the fracture; it becomes a medullary

Fig. 1. Case 1. Skiagram of left tibia immediately after injury.

Fig. 2. Case 1. Skiagram of tibia in plaster cast after attempted reduction, showing the impaction of the fragments of the fibula which prevented reduction.

[1] Read before the Chicago Surgical Society, February 6, 1914.

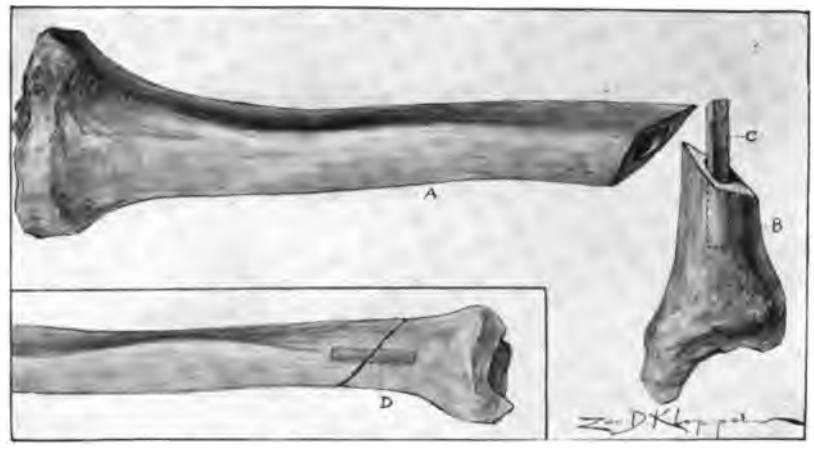



Fig. 3. Diagram of insertion of medullary bone splint.

Fig. 4. Case 1. Skiagram anterioposterior view, after insertion of medullary bone splint in the tibia.

Fig. 5. Case 1. Skiagram lateral view.

Fig. 6. Case 2. Skiagram spiral fracture of left humerus slightly comminuted.

bone splint and remains as long as its support is required by the injured bone, and then the superfluous part is gradually absorbed and the medullary canal reëstablished.

In the cases reported, bone material was taken from the opposite tibia and placed in the medullary canal at the point of fracture, doweling the fragments together in a substantial manner.

Homogeneous living bone from the same individual is treated kindly by the tissues, and no matter whether it grows in and becomes a part of the bone, or whether it acts as a scaffold for new bone-cells, or whether it eventually is absorbed in whole or in part, it will be treated kindly by the tissues and will retain its integrity as a splint long enough for repair of the fracture to take place.

CASE 1. L. K., fracture of both bones, left leg. American, laborer, 33 years old. Alcoholic, specific. Slipped on the ice and fell, breaking his leg; admitted to Cook County Hospital at once, January 10, 1914 (Fig. 1).

Fig. 7. Case 2. Skiagram of the humerus after insertion of medullary bone splint.

Delirium tremens — treatment in fracture box one week. Attempted reduction, plaster cast, position unchanged (Fig. 2). Open operation with insertion of medullary bone split, January 24, 1914.

Incision over fracture showed a spiral fracture of tibia with three-fourths inch shortening, irreducible by traction on the foot and manipulation with levers at the fracture, on account of the impaction and entanglement of the fragments of the high-up fracture of the fibula. A transverse chisel fracture of the fibula was made from the outside which permitted reduction of the tibia.

A piece of bone three inches long and one-half inch in thickness in each direction was removed from the opposite tibia, without its periosteum, to serve as a medullary splint for the fractured tibia.

The part of the leg below the fracture of the tibia was turned at a right angle to the leg and the bone splint was driven into the medulla of the lower fragment of the tibia with a lead hammer sufficiently deep to make the splint firm and solid.

The medulla of the upper fragment was cleaned out with a sharp bone spoon to receive the upper end of the bone splint (Fig. 3).

The part of the leg below the fracture, placed at an angle to the axis of the leg with the end of the bone splint protruding from the medulla of the tibia, was manipulated so as to enter the end of the bone splint into the medulla of the upper fragment of the tibia and swung into proper position.

The muscles immediately retracted and held the fractured end firmly in position (Figs. 4 and 5).

The bone splint was fitted solidly into the medulla of the lower fragment, but loosely into the medulla of the upper fragment.

It was necessary to have the cavity in the upper fragment slightly larger than the bone splint, because it could not enter the medulla in a straight line, but must enter in the arc of a circle, the radius of which was equal to the length of the projecting bone peg and the portion of the lower fragment of the tibia which projected above the soft parts, during the manipulation of swinging the lower fragment into position.

CASE 2. O. S., fracture of left humerus. American, clerk, 37 years of age. Fell from porch while intoxicated, breaking his left arm; admitted to Cook County Hospital at once; mobility and angular deformity in upper third of humerus with one inch shortening. Attempted reduction and immobilization with moulded plaster splint (Fig. 6).

Open operation with insertion of medullary bone splint. Incision over fracture showed a spiral fracture of humerus three inches in length, overriding one inch.

A piece of bone without periosteum, five inches long and one-half inch in thickness in each direction, was removed from the tibia and inserted into the medulla of the humerus at the fracture (Fig. 7).

---

# A NEW SELF-RETAINING ABDOMINAL RETRACTOR AND WOUND PROTECTOR

BY U. C. BATES, M. D., SEATTLE, WASHINGTON

THIS retractor consists of an oval frame eight inches wide and nine inches long. To this are fitted four retractor blades that work through slots in the frame. These are held in any degree of retraction desired by a ratchet device which may be released by pressing a button on each blade. These blades work through a funnel-shaped piece of rubber so that when the retractor is in place the margins of the incision, as well as the field of the abdomen covered by the rubber, are completely protected from septic material from within or without. This also obviates the use of towels applied to the margin of the skin incision.

By means of this retractor any degree of retraction in any direction required may be obtained, thereby exposing any quadrant of the operative field desired. It enables the operator to get a larger field through a smaller incision. By reason of its self-retaining properties the abdominal wall can be raised which materially assists in introducing the packing gauze used to cofferdam the intestines from the field. After the packing gauze is in place it is retained there by the tension of the abdominal wall and the upper blade of the retractor. The rubber stretching from one blade to another makes retraction over the whole circumference of the wound, thus preventing pressure and traumatism by the blades, and the pressure of the rubber prevents any oozing from the wound surface.

Retractor partly open.

# PRESENT STATUS OF JOINT DISEASES AND BEST METHOD OF TREATMENT[1]

By EMIL G. BECK, M. D., Chicago

I WISH to briefly review the latest advances in the etiology, diagnosis, and treatment of the acute forms of joint infections, laying a great deal of stress on vaccine therapy. Also to consider the more chronic forms as follows:

A joint disease is, in practically all cases, a secondary infection, except in cases of direct injury. Whatever type of microörganism it is, it is liable to reach the joint through circulation. There are three forms of joint affections which we meet most commonly:

First. Those of pyogenic origin.

Second. Tuberculous origin.

Third. Syphilitic origin.

Further, the very chronic polyarthritic diseases, the etiology of which is not yet fully known. By some they are thought to be a most chronic type of infection of the joint and the para-articular tissues, and again by others as nutritional changes which tend to the deposition of salts in the joints and ligaments.

The first step in the treatment is a correct diagnosis. I need not mention all the aids we have at our command, but I shall speak of the aid of the stereoscopic radiograph in making a differential diagnosis. I have made an extensive investigation of this method for several years, and have concluded that I am able to make, with exactness, a differential diagnosis and ascertain the progress of the disease, with this method.

I emphasize that the radiograph must be stereoscopic, otherwise the finer differential points are lost. The stereoscope produces a concrete picture of the fine details of the diseased structure, which brings out the differential points. A single picture is, so to speak, out of focus, and gives only the rougher points, which will confuse even the best diagnostician.

Before the era of Pasteur's discoveries the mortality of surgical treatment was most frightful, and the surgeons, discouraged, hesitated to operate. According to Follin's figures, the mortality at that time, due to operations of hip or spinal caries, was 56 per cent to 70 per cent, and now, after half a century of diligent study, work and discussions, surgeons have, to a certain extent, practically agreed on a treatment for surgical joint affection.

When, in spite of all efforts to check the progress of the disease, it still progresses, we are faced with a proposition the solving of which surgeons are not yet agreed upon.

The surgeon who can correctly solve this problem will save many lives and reduce the big army of cripples. It is the treatment of cold abscess to which I refer. The attitude of the physician toward the treatment of this condition is of the most vital importance to the life of the patient. Too many physicians still believe that a fluctuating cold abscess should be opened and drained by a rubber tube. This procedure is more dangerous than most any disregard for surgical asepsis. Calot says: "The physician who opens a cold abscess and drains it with a tube opens the door through which death nearly always enters."

What then would be the proper procedure? Should we wait until it ruptures spontaneously? *No.* It should be treated by puncturing with a trocar, allowing some of the fluid to escape, and then be injected with a modifying substance, such as Calot's mixture, formalin or bismuth paste, etc. In the past six years I have used bismuth paste (10 parts bismuth subnitrate and 90 parts yellow vaseline). All these methods are fully described in textbooks.

If, in spite of this procedure, secondary infection should take place and a chronic suppuration persist, then I recommend the injection of bismuth paste.

It is now about eight years since this method was introduced into surgery and it has, from the beginning, had many adherents, and has been tried not only in hospitals and clinics here and abroad, but has been used very extensively by country practitioners.

Some authors have obtained better results than we have, others have been only partially successful, and in the hands of a few the method has been a failure.

If we take into account, however, that we have to deal with a class of cases which have already been treated surgically and otherwise, without success, we must regard even the smallest percentage of cures as an actual gain. The analysis of reports from all sources, however, indicates that on an average of more than fifty per cent of these apparently hopeless cases were finally cured by these injections.

You are familiar with such cases. They con-

[1] Read before the Chicago Surgical Society, February 1914. (See discussion p. 774.)

stitute the scum of surgical refuse, cases in which every sect of medicine and surgery, and even quackery, have had a chance. Two of this class of cases in our series had lasted forty years, and many had had from ten to fifteen surgical operations.

My purpose is not to show what results I personally can obtain with this method. After all, you are interested in what you yourselves might accomplish, and, therefore, instead of citing percentages of cures, I shall select a few cases for illustration.

Are there other methods in vogue which will compare in their final results with this method? There are.

First. Heliotherapy, as carried out in Switzerland by Dr. Rollier.

Second. X-ray treatment systematically applied.

Third. Vaccine treatment.

Fourth. Surgical treatment, either conservative or active.

Let us compare the results which have been obtained with these different methods, taking for comparison from the literature reports made by the men who advocate these various methods.

HELIOTHERAPY

Dr. A. Rollier makes a complete report of 1,129 cases treated by sunlight in Leysin, a period of ten years from 1903 to 1913. Of the 1,129 cases, 445 cases were of joints and 198 cases of spondylitis which properly belong to joint disease.

| | |
|---|---|
| Coxitis | 158 |
| Gonitis | 120 |
| Foot | 94 |
| Shoulder | 12 |
| Elbow | 30 |
| Hand | 21 |
| Polyarthritis | 10 |
| Spondylitis | 198 |
| Total | 643 |

Of this number, 343 were closed tuberculosis without abscesses, 151 closed tuberculosis with abscess formation, 149 open tuberculosis with existing sinuses.

Of 343 cases of closed tubercle bacilli joints, 311 were cured, 28 were improved, 3 were not improved and 1 died. Mortality not ⅓ per cent.

Of 151 cases in which abscesses formed, 134 were cured, 10 were improved, 5 were not improved, 2 died. Total, 151; 1½ per cent mortality.

Of 149 cases with sinuses, 106 were cured, 24 were improved, 8 were not improved, 11 died. Total, 149; 7 per cent mortality.

Since Dr. Rollier does not resort to surgical procedure, but relies upon the curative effect of sunlight alone, we already have a proof that treatment without surgical intervention may produce very excellent results. His observations, experiments and theories as to the *modus operandi* of sunlight treatment are very instructive, but I cannot here go into their details.

THE RONTGEN THERAPY IN JOINT AFFECTIONS

B. Baish, of Heidelberg clinic, reviews the subject and gives the report of his own results.

The last reports of Dr. Iselin were so favorable that they gave a new impetus for trial in many clinics abroad, but no one could produce such results as Iselin reported. This may not be Iselin's fault, but that of other operators.

Baish treated 80 cases of joint tuberculosis, five of which were operated and 18 still being treated, leaving 57 cases in which treatment with X-ray has been completed. Results were as follows: 30 were cured, 17 were improved and 1 died, 10 were not improved and 3 died. Total, 57.

Most of these cases were in the late stages with sinuses, and thus with the X-ray treatment alone a cure of 30 cases out of 57 has been produced—a most remarkable showing of what X-ray alone can do in these progressed cases.

Baish states, however, that in some of these cases they had applied the bismuth paste, and some of his illustrations show that it had been used. Therefore, in these cases the objection could be raised as to whether the X-ray alone was responsible for the cure, since we have cases of this kind on record which have been cured by bismuth injections alone without the application of X-ray.

He cites that Schede has recommended that the cases be treated with radiation, and on the fifth day after the first application they should be injected with the bismuth paste, and in that way the best results could be obtained.

We now come to the consideration of the purely surgical treatment, and here I can do no better than cite the report of Professor Garre, made before the last Congress of the German surgeons in Berlin.

The report comprises material from the clinics of Rostock, Koenigsberg, Breslau and Bonn, covering a period of nineteen years' work, a collection of one thousand cases, which were treated at these different clinics under his own supervision.

He reports 261 cases of tubercular coxitis. Of these they could trace only 168, and 102 of this 168 were still alive, 62 having died—a mortality of 37 per cent.

Of the 168 cases, 71 were cases of closed tuberculosis without abscess. Eight were treated by resection with two deaths, a mortality of 25 per cent. Sixty were treated conservatively with 17 deaths, being a mortality of 28 per cent.

Fifty-nine cases had abscesses, of which 23 had resections with 13 deaths, a mortality of 56 per cent.

The remaining 31 cases had fistulæ, 16 of which were treated by resection, of which 5 died, being a mortality of 31 per cent. Twelve cases were treated conservatively, with 3 deaths, making a mortality of 25 per cent.

They have treated 454 cases of knee-joint tuberculosis, 268 of which were resected. They have cured 88 per cent, improved 5½ per cent, recurrence 1 per cent, amputation 3¾ per cent, deaths 2¼ per cent.

Two hundred and twenty-two ankle cases were treated, 80 of which were resected, with excellent results in 24 cases (30 per cent); good results in 25 cases (31 per cent); passable results in 10 cases (12½ per cent); not good results in 10 cases (12½ per cent) and 6 deaths (6½ per cent). On two cases there was no report.

Of cases of tuberculosis of the shoulder they treated 25, 8 being treated conservatively and 17 surgically, 12 of the latter being resected and 5 excochleated. Of the 8 treated conservatively, 1 left hospital, 4 got better, 1 had to be resected later and 1 got better much later.

Of the 12 resected, 8 cases were cured, 3 improved, and 1 not improved and subsequently died.

Of tuberculosis of the elbow, 79 cases were treated: 17 conservatively, 2 cured, 14 improved, 1 not improved; 19 excochleated, 5 of which were cured, 7 improved but fistulæ formed, and 7 not improved; 38 were resected, with a result of 25 cured, 10 not improved, and 3 died of general tuberculosis; 4 had amputations and were cured; 1 case an arthrectomy was performed with improvement as a result.

Forty cases of tuberculosis of the wrist were treated. Of the 13 treated conservatively, 9 healed and 4 did not; of the 14 excochleated 10 were cured, 3 improved, 1 not improved; 2 extirpation of tendon, both cured; 5 were partly resected with 3 improvements and 2 subsequent amputations; 1 complete resection with cure; and 5 cases were amputated with cure as a result.

The great mortality which surgical treatment produced would of course discourage anyone from bringing it into comparison with the conservative methods, but to be just, in making comparisons, we must consider that the present surgical methods do not produce the same mortality as they did nineteen years ago, in which period Professor Garre's cases date. Nevertheless the mortality is so much greater that, even in the hands of the very best men, like Professor Garre, results are not to be compared with those of the conservative methods.

I regret that I am unable to give full statistics of my own cases, treated during the past six years. To prepare such report would require several months' tracing of the patients, but it comprises a series of 650 cases of tubercular joints, at least ¾ being in the latest stages in which abscesses or sinuses have formed.

Thus we dispose of a material of the suppurative type much larger in volume that that of Dr. Rollier or Professor Garre, and useful comparisons can be made only by comparing the same types of cases, namely, those in the late stages. The average percentage of cures in our series was 72 per cent with a mortality of only 3 per cent, the remainder of the cases being either improved or unchanged.

Thus it is evident that the conservative methods of treatment are far preferable to the aggressive surgical procedures, but we regret to say that as long as the poor classes of people cannot avail themselves of such protracted treatment as is carried out at Leysin, the active surgical procedures will have to be resorted to.

# X-RAY FINDINGS IN THE NORMAL STOMACH[1]

By ADOLPH HARTUNG, M. D., Chicago

RÖNTGENOLOGY has rendered possible examination of the human stomach in the living individual under ordinary conditions and herein lies its greatest value as an aid to diagnosis. But the information thus obtained has forced us to change many of our conceptions of that organ which were based on less accurate clinical methods of examination, and the findings on the operation and post-mortem table where conditions were entirely different.

Before considering the stomach itself, I shall briefly describe the technique employed in the röntgen examination. To render the stomach visible by the ray, a meal is given consisting of about 350 grams of some palatable media such as gruel or fermented milk containing about 50 grams of bismuth oxychloride or 100 grams barium sulphate, either of which are practically inert and tasteless. The little additional specific gravity they induce is negligible for practical purposes as has been proven experimentally. This should be given on an empty stomach, and if marked constipation has been present it may be well to precede it by a cathartic, otherwise not, for our aim is always to approximate ordinary conditions as closely as possible. The shadow of this meal in the distended or moderately contracted stomach gives us a fairly accurate representation of the stomach itself.

As to the methods employed, several are in use. The röntgenoscopic consists in placing the patient before the fluorescent screen and directly observing the filling of the stomach, its contractions, and its emptying. This may be supplemented by palpation with the gloved hand or specially constructed palparium. With the protective devices now in use, such an examination can be made with practically no danger to the patient or operator. This method, although the simplest, is also the most difficult for it necessitates an eye which has been trained to see quickly and accurately moving shadows which to the occasional observer are exceedingly dim, indistinct, and meaningless. The röntgenographic method, on the other hand, gives more clearly defined pictures of the stomach at any one instant, and if enough negatives are made, as in the serial method advanced by Cole, of New York, practically all the phases of contraction can be studied in detail at one's leisure. The patient ought to be examined in different positions to get all the information available. A combination of the two methods is undoubtedly the best procedure. A third method, the cinematagraphic, as first shown by Kaestle-Rieder-Rosenthal, combines many of the advantages of the other two but owing to the big expense it involves it is hardly practicable.

To describe the normal of an organ of which it has been said that the only constant thing about it is its changeableness is exceedingly difficult. When empty it is contracted so that its walls lie in contact except near its cardiac end where they are slightly separated by an air bubble—the so-called "Magenblase." The full stomach, as seen with the aid of the röntgen ray, in no wise resembles the type we ordinarily see pictured in our textbooks on anatomy, and which was first described by Luschka in 1873. This is what Forsell calls the passive type of stomach and can be approximated by our distending the organ with gas when the tonus of its musculature is overcome and we have a record only of its fibrous and elastic elements as represented by its submucosa. The anatomic shape of the stomach in the living is determined largely by its musculature and it is this shape we see with the aid of the röntgen ray. As long ago as 1881, Lesshaft, before the medical congress in London, said, "The stomach is usually vertical, its fundus touching the diaphragm, its lesser curvature to the right, its greater to the left and downward; the antrum pyloryi turns up and to the right (occasionally backward) as it connects with the duodenum." This practically corresponds to our röntgen ray experience. Fully 80–90 per cent of the normal stomachs conform to this type when examined in the upright position. This is the so-called fish-hook type of Riedel or siphon form of Groedel. The other 10–20 per cent belong to the cowhorn type of Holzknecht, the pylorus forming the lowest point, the stomach gradually tapering down to this point obliquely from the left above to the right in about the median line. In the horizontal position the shape of the stomach is extremely variable, depending on decubitus, pressure, and location. Schlesinger has divided stomachs into four types depending on the tonus of its musculature: (1) the hypertonic or cowhorn, (2) the orthotonic or fish-hook, (3) hypotonic where the greater and lesser curvature are approximated more than usual and the caudal end somewhat enlarged, and (4) the atonic, an exaggerated form

[1] Read before the Chicago Surgical Society, December 5, 1913. (See discussion, p. 771.)

of the hypotonic. The shape of the individual has much to do with the shape of his stomach, a broad abdomen with wide intercostal angle predisposing to the cowhorn type and a long narrow abdomen to the vertical type. Other factors which may cause variations in shape of the normal stomach are respiratory movements, overdistention of the colon with gas or fæces, tumors or displacements of other organs, and changed contours due to clothing, such as corsets.

The position of the filled stomach depends largely on the position assumed. In the upright its greater portion lies on the left side, the pylorus being located just to the right of the median line. In the horizontal posture it usually extends farther to the right. In males it occupies a little more oblique position than in females. Its size and shape also markedly influence location. There are practically no normal limits clearly definable, for many stomachs producing no symptoms whatever, are found to extend considerably below the umbilicus.

As regards size, this too varies within wide limits. Ordinarily we do not try to distend the stomach to its utmost. Most of our examinations are made with a fairly definite amount (400 grams) of the opaque meal. In the normal the stomach walls adapt themselves around this by virtue of their tonus or so-called peristole. If a greater amount is given, the stomach increases uniformly as long as its tonus is intact. Beyond that point we get the volume of the passive stomach which may vary from 1000 to 2000 ccm. or more.

So much for the stomach at rest. But before passing on to the actively contracting stomach, I wish to call attention to the conflicting nomenclature in use as applied to the different parts of the stomach. Some of the anatomists and röntgenologists divide the stomach arbitrarily into parts as was done by Luschka long ago. More recently an attempt has been made to divide it on anatomic and biologic lines notably by His, Jonnesco, and Forsell. The last named author divides the stomach into a digestory sac and egestory canal. The former he subdivides into three parts: 1. The fornix ventriculi, which constitutes approximately the upper one-third, and is limited by the upper segment loop of muscles, is occupied largely by the "Magenblase" in the filled stomach, and has little or no peristaltic movement. 2. The corpus ventriculi which extends to the level of the bend, and is limited below by the lower segment group of muscles. 3. The sinus ventriculi, the "Magensack" of other authors, occupies the caudal pole between the corpus and egestory canal, and serves as a reservoir for the food before it is emptied into the duodenum. The egestory canal is that portion of the stomach beyond the bend. It is marked proximally by a deep ring contraction (often referred to as a sphincter), extending from the incisura at the angle of the lesser curvature to a shallow sulcus directly underneath. The pylorus forms its other boundary. It is the part commonly referred to as the antrum, and is the most active in forcing the food out of the stomach.

Now, then, as regards the stomach in action: If the filling process is watched, the food, after it passes through the cardia, drops to the bottom of the air sack, the collapsed stomach walls gradually open like a funnel, and the food slowly passes to the caudal end of the stomach. The first mouthfuls seem to follow in groove arrangements along the lesser curvature, called the "Magenstrasse" by the Germans. As more food is taken the greater curvature gradually moves away from the lesser, and the characteristic stomach shape is produced. When the stomach is filled, various types of movement can be observed. Groedel divides these into rhythmic and arhythmic contractions. The rhythmic may be so shallow as to be scarcely visible, but as digestion proceeds, or if the stomach is stimulated as by pressure against the screen, they become more forcible. Their function is to thoroughly mix the contents. The waves start at about the junction of the fornix and corpus as shallow depressions, and become gradually deeper toward the pylorus. At the beginning of the antrum they at times almost completely shut off the lumen, and move toward the pylorus as a concentric ring, forcing the contents through the pylorus if it be open or allowing them to return into the stomach, if not. Often a second or third wave starts before the first has reached the pylorus. The time necessary for a wave to travel from its starting point to the pylorus varies from eighteen to twenty-eight seconds: it traverses the length of the antrum in about eight seconds.

The arhythmic contractions are very small ones, seen along the walls of the greater curvature of the corpus only, and are believed to have to do with digestion itself. Forsell thinks they may be movements of the rugæ, induced by the muscularis mucosa. If the stomach contents are markedly acid the peristaltic waves are usually deeper and more forcible. The stomach contents, as they are forced through the pylorus into the first portion of the duodenum, usually assume a regular triangular shape, called the caput or cap.

As the stomach becomes empty and hence becomes more permeable to the ray, rugæ or folds can frequently be seen. The same picture can often be produced by pressure when the stomach is filled.

As regards the emptying time of the normal stomach, much depends on the type under consideration. The hypertonic type can readily empty itself in two hours, the orthotonic in four, the hypotonic in six, and the atonic in eight. Six hours is usually considered the limit of the normal. One precaution is necessary in determining this, that the patient take no food or drink after the original meal, until after the examination for motility has been made.

Close attention to the variations in the normal will often obviate faulty interpretation of the apparently abnormal.

---

# VARICOCELE OPERATIONS

By WELLER VAN HOOK, A. B., M. D., Chicago

THE enlargements of the veins of the spermatic cord are so common among young men that they are met with by every practitioner of medicine. They require no further treatment, in the majority of cases, than the use of a suspensory bandage. But if this is used it must be selected and applied with care.

Operations are indicated only where great discomfort resists treatment by support, or where the testis shows signs of incipient atrophy.

The standard and typical operation is that of the partial excision of the veins of the cord. The shortening of the scrotum by excision of the dependent part is an occasional requirement, indicated only in cases where there is extraordinary laxity.

*Shortening the scrotum* is often done in a haggling, unsurgical manner which is unnecessary if one understands the difficulties and knows how to avoid them.

The skin is not the only structure which supports the contents of the scrotum. They are upheld chiefly by the dartos and the spermatic cord. Furthermore, the peculiar structure of the skin must be remembered: it contains a large amount of unstriated muscle tissue. When the scrotum is shortened with scissors great changes in its form and the relations of its walls occur. This is due largely to the contraction of the involuntary muscles and of the connective tissues.

Hence transection of the skin is at once followed by violent and very irregular contraction of the various structures. Much bleeding occurs and, worst of all, some of the vessels, especially the numerous dilated veins, are likely to cease bleeding under pressure and coagulation only to begin bleeding some hours later. The writer has had this most embarrassing experience.

To overcome these difficulties he now operates as follows:

Draw the redundant part of the scrotum through the varicocele clamp with care as to the following details:

1. The clamp must lie in the median anteroposterior plane in order that the incision-scar may be continous with the scrotal raphé. This incision leaves the scrotal walls well supplied with blood-vessels.

2. Apply the extra support in the middle of the clamp.

3. See that the clamp is so firmly and evenly adjusted that all tissues are compressed alike, but not excessively.

The clamp (Fig. 1.) he uses was especially designed by him. It is heavier than the common clamp and better made. Its shape gives it special advantages in power and in adjustment. The scrotum is so lax that it can easily be drawn through the clamp to the production of any desired shape of stump. It will be understood at once that the more the tissues are drawn through near the ends of the incision the more sharply will the wound curve back toward the body.

Even this powerful clamp springs at mid-point when under heavy pressure. Hence a reinforcement was provided in the screw pressure clamp indicated.

Now, having applied the clamp, cut away with strong scissors the redundant tissues leaving at least one-eighth of an inch of tissue beyond the jaws of the clamp. Next insert silkworm gut stitches through the suture openings in the clamp, using straight Hagedorn needle. The clamp as designed by the writer has such suture-openings as will easily "take" the threaded

needle. The sutures are to be tied immediately upon introduction and they must be drawn firmly to prevent hæmorrhage.

When all sutures are tied the clamp is removed and any needed intermediate sutures are applied. The wound must not be dressed until all hæmorrhage has been arrested. But no trouble is likely to occur if the clamp is carefully applied and the sutures accurately placed.

The sutures must be left until they can be seen to be no longer acting as supports.

*Excision of some of the veins* of the cord is usually all that is needed to overcome the difficulties of severe though not extreme cases of varicocele.

This operation, also, can be much simplified by the following method:

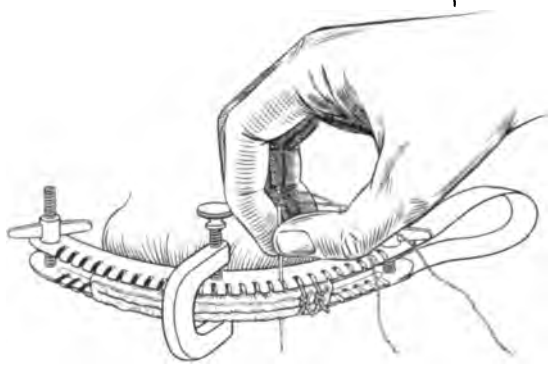


Fig. 1.

Make an incision between three-quarters of an inch and one inch long, passing through the skin and dartos (Fig. 2). This is facilitated by lifting the entire cord, holding it up against the skin in front of the forefinger and thumb of the left hand. Now the various connective-tissue layers are incised by quick, light touches of a small, very sharp knife, until the vein walls roll out free.

The connective tissues need not be individually recognized or studied. Look only for the veins and quickly expose them. Next pull out the veins sharply; find the vas deferens by touch—it feels like a small hard whip-cord. Having found it push it toward the scrotum with one vein. The remaining mass of veins is to be excised.

Pull out the veins by drawing towards the testis and then toward the inguinal canal till no more vein tissue slips out and tension is strong. Tie carefully and strongly each side of the loop with tested catgut leaving long one of each of the ligature ends. Cut out the loop of veins and tie together the ends of catgut that were left long. This at once removes the redundancy of vein tissue, restores the continuity

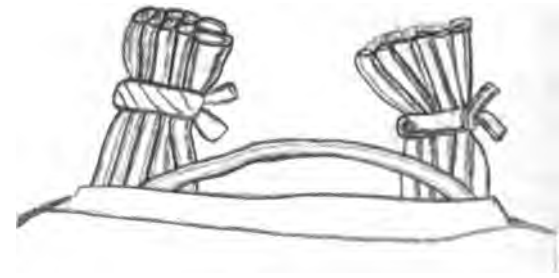


Fig. 2.

of the spermatic cord and raises the testis to its normal position. In the great majority of cases the scrotum retracts to support the testes in a satisfactory manner and the incipient atrophy is arrested. But a testis that has once lost something of size or consistency is not likely wholly to regain the normal state.

The small incision in the skin may be closed, after dropping into the scrotum the united stump of the cord without paying any attention to the fascial structures, the small wounds in which give rise to no disturbance. Four or five silk-

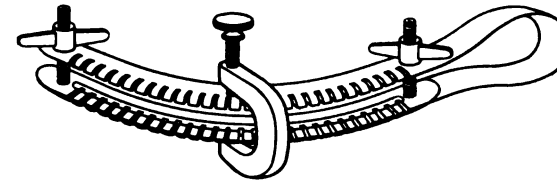


Fig. 3.

worm stitches suffice. Care is to be taken that the wound is well supported for about ten days lest its edges separate under the action of the muscular and connective tissues of the scrotum wall. A suspensory bandage should be worn if pain is experienced. But this soon ceases to be needed.

# A CLAMP INTENDED TO FACILITATE THE SUTURE-ANASTOMOSIS OF HOLLOW VISCERA

By WILLARD BARTLETT, A. M., M. D., Saint Louis

At the present time most operators of experience in stomach and intestinal work find it convenient or even necessary, in making an anastomosis, to employ an instrument which subserves three purposes; viz., (a) holds the viscera fixed in a desired position, (b) prevents the escape of contents, (c) produces hæmostasis.

When the need of some such appliance first became apparent, the surgeon chose quite naturally the Doyen elastic pedicle forceps, this being more nearly applicable than anything else found in the ordinary hospitable armamentarium.

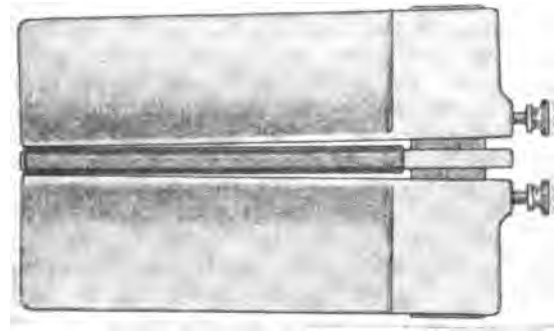
It does seem surprising, however, that this simple instrument or modifications of it should have continued so long in this use, when its obvious disadvantages are considered. It cannot exert an even pressure along the full extent of its blades, as is readily seen when its structure is taken into account. Near the "joint" a crushing force is exerted, while between the free ends may be had just the desired compression and at the same time the viscus be slipping back at a point midway between these two extremes. At best, the operator has very little idea of just how much force is applied at any given point since it is indirectly exerted in the manner of a lever acting on a fulcrum. Furthermore, the pressure cannot be delicately graduated on account of the distance intervening between the catches.

The accompanying drawing gives the details of an instrument which I have employed since June, 1913. Its broad flanges are five inches (twelve and one-half cm.) long by one and three-quarter inches (four and one-half cm.) broad, being ample for any purpose and still never too large as shown by the fact that I have employed them in making an anastomosis on a small dog. The entire apparatus is cast in aluminum, hence is surprisingly light, when its size is considered.

It is used in a gastro-enterostomy as follows: The bowel is compressed by the thumb and fingers of one hand directly forcing the middle blade and one lateral blade together upon it, while the other hand tightens a set screw; this maneuver then is repeated with the stomach on the other side of the instrument.

As is shown in the cut, the lateral flanges are swung closer together at their free ends than at their bases by the set screws. This is necessary to prevent the viscera tending to slip out of their grasp.

A little practice will enable anyone to apply the contrivance easily and speedily, although this



Bartlett's Anastomosis Clamp.

may not seem so the first time it is used by one accustomed to the elastic clamp only.

The following advantages may be fairly claimed for the contrivance:

1. It compresses the viscera evenly throughout its entire length.

2. The amount of compression is known, being directly applied and controlled by the surgeon's fingers.

3. The most delicate adjustment of the instrument is possible.

4. When locked in position it constitutes a thin metal plate about five inches (twelve and one-half cm.) by four inches (ten cm.) which effectually prevents protruding viscera and gauze packs from getting into the field of operation. It goes without saying that the probability of soiling is thereby lessened.

# AMNIOTIC MEMBRANE FOR THE PREVENTION OF POST-OPERATIVE PERITONEAL ADHESIONS

## A Preliminary Note

By C. B. LYMAN, M. D., Denver
Professor of Surgery, University of Colorado
AND
W. H. BERGTOLD, M. D., Denver
Attending Physician, Saint Joseph's Hospital

MANY abdominal operations result in adhesions, not because of faulty technique, but through the necessity of breaking up adhesions in existence prior to operation. Such separated adhesions usually recur promptly after operations, and it seems to us that this constitutes one of the weak points in abdominal surgery, because no method has been devised which will positively prevent such recurrence. It is also very desirable that some method be invented to prevent, primarily, the formation of peritoneal adhesions where the operative procedure unavoidably causes large areas of peritoneum to be denuded of endothelium. Obviously, what is needed is some method which will prevent organization of the plastic material that temporarily covers the raw peritoneum, and will keep such denuded surfaces apart long enough to permit complete endothelial resurfacing. It is probably true that such a device is needed only during the first forty-eight hours after operation, a period which is sufficient to allow complete repair of the denuded peritoneal surfaces.

It seems to us that, up to the present, all methods aiming to prevent peritoneal adhesions have been largely or wholly unsuccessful, except, of course, where the conditions permit of covering denuded areas by plastic operations, methods applicable, at best, to a very limited number of cases. The ideal procedure would seem to be the interposition between the denuded areas of some kind of thin animal membrane: it would have to be sterile, non-irritating, and capable of being absorbed, yet resistant to absorption for at least forty-eight hours after operation. Various tissues have been utilized for this purpose, mainly Cargile's membrane; this, however, is not to be obtained in very large pieces, which renders it more or less useless when one has to deal with extensive areas of denudation.

Many animal membranes have been considered by us, but all have been rejected, either as too difficult of absorption, too difficult to secure sterile, or too unyielding to be safe.

It finally occurred to one of us (Bergtold) that amniotic membrane might be suitable in every way for the purposes in mind. The following case history of a patient under the care of one of us (Lyman) describes the method of preparation and preservation of this membrane, the technique of its use, and the apparent result:

The patient, a woman of 25 years, had been operated upon for appendicitis some seven years previous to coming under observation here; she was operated by one of us (Lyman) for gastric ulcer two years ago, a posterior gastro-enterostomy and freeing of many adhesions being done. Following this operation she had symptoms which could be explained only by the existence of abundant recurring peritoneal adhesions in the upper part of the abdominal cavity, and in November last an operation was done for the purpose of correcting this condition. Very extensive adhesions were again found, adhesions which involved the liver, gall-bladder, duodenum, stomach and transverse colon. These were all freed, the raw surfaces smeared with sterile oil, and the abdomen closed. Within a week there was a return of all the symptoms which had existed prior to this last operation, and continued for five weeks, at the end of which time it was decided to again open the abdomen, and employ chorionic membrane to prevent new adhesion formation. This was done on December 20, 1913, when three sheets of chorionic membrane were used each about five inches square. One was interposed between the liver and gall-bladder, and the duodenum and stomach, the second was placed between the transverse colon and small intestines beneath the colon, and the third was placed under the abdominal incision, all three sheets being held in place by catgut stitches.

It is now more than five months since this last operation, and the patient has remained entirely free from the distressing symptoms which had previously been in existence for many months.

This membrane seems especially suitable for work of this nature, in view of the fact that it can be obtained in sheets of large size, that it is sterile to start with, that it is easily preserved and kept sterile, and that it is thin and probably easily absorbed.

The material (amniotic membrane having been selected by Lyman) used by us was obtained from a patient free from constitutional disease; it was prepared by washing in running water for two hours and then kept in one per cent lysol solution until needed. The one objection to it, so far as

we have had experience, is that it is slippery and friable when prepared by the method detailed above. We believe this objection can be overcome by placing the membrane in absolute alcohol for a few days, preserving it in 50 per cent alcohol, and washing it thoroughly in sterile, normal salt solution before using it.

We hope to publish the results of animal experiments designed to test the method.

This preliminary note is published in order that the method may receive early attention, and be subjected to test at the hands of our colleagues. It would seem to us, in so far as one can ever draw conclusions from one experience, that we are justified in feeling—

A. That this method is harmless.

B. That it does prevent the formation of peritoneal adhesions.

C. That it is easy of application.

D. That it is worthy of further trial.

NOTE.— Since the above was written, Lyman has employed this method in six other cases, in all of which the results have been eminently satisfactory, the preëxisting symptoms due to adhesions not having recurred up to date. Since the first operation we have been preserving the membrane in one-half per cent solution of formaldehyde in seventy per cent alcohol.

---

# THE ELECTRIC DRILL, SAW, REAMER, AND TREPHINE IN BONE SURGERY [1]

BY CHARLES GEIGER, M. D., SAINT JOSEPH, MISSOURI

FOR some time those who are engaged in the practice of surgery have realized the necessity of modernizing the instruments and methods employed in operating upon the head and large bones. The old crude method of employing the chisel, hammer, and hand drill are unscientific procedures, requiring too much valuable time, and exhausting the patient.

In modern bone work it is absolutely necessary, in some cases, to remove bone-grafts varying from two to ten inches in length. The only correct method to do this is with the electric circular saw. In the latest treatment for Pott's disease, a bone graft is taken from the tibia of the individual suffering with this disease, the length of the graft depending upon the number of vertebræ that are diseased. The graft extends into at least one healthy spine of the vertebra, above and below the diseased member or members. In fractures that cannot be held in apposition by methods commonly used, and also in ununited fractures, in place of Lane plate, bone-grafts are used. The grafts are usually taken from the tibia. After the ends of the fractured bones have been reamed out with the electric reamer, the graft is inserted into the ends of the fractured bones. All bone-grafts must fit snugly, otherwise they are liable not to grow. The operator should always keep in mind the importance of preserving the periosteum on the graft, as the periosteum has much to do with the blood supply and with the life of the graft.

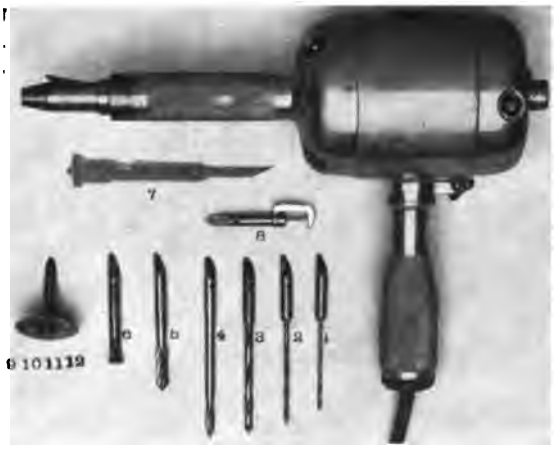
Eminent surgeons have found that handling, manipulating, and trauma are the causes of infection in bone grafting, operating on ununited fractures, or any plastic bone work, and the slightest infection is destructive and hazardous to good results. The above causes of infection are eliminated by the use of this set of instruments.

The object of this instrument or device is to supplant the cable, which usually conveys the power from the motor to the instrument; the cable has been used by all other motor bone sets. It is always in the way, and if bent at right angle, or at any acute angle, while it is running, it will generate heat, and its action be retarded. The Geiger device, motor and all, is held in the hands of the operator, and gives firmness and rigidity to the instrument on account of the weight and firmness with which it can be held. The operator, by a motion of his thumb, turns on or off the electricity without any effort, as it is always at his thumb's end.

Owing to the weight and firmness with which the instrument can be held, and the motor being under perfect control, the operator is absolute master of the situation, while using any one of the instruments, in the most delicate bone operation.

This instrument which I have devised comprises a one-fifteenth horse power, universal 110 volt motor. The housing is aluminum. The motor is wound with an enameled wire. The enameling is baked on with a temperature of 1000 degrees F., and all connections are insulated

[1] Read before the Academy of Surgery, Saint Joseph, Missouri, February 2, 1914.



with a special insulation (Bakalized fiber). The switch is made of dilecto. There is nothing about the motor that can burn or be melted with a temperature lower than 130 degrees C., which gives us an assurance that the motor can be thoroughly sterilized, with dry heat, without harm.

The speed of the motor is 7000 R. P. M., reduced with a double set of cogs to 400 R. P. M. The back gearing of the motor increases the torque at the instrument seventeen times, thereby giving all the power that is required. It has a handle and a hand piece which are cast integral with the housing of the motor. The hand piece gives firmness to the chuck. By reason of the construction, the operator has perfect control of the instrument.

The handle and hand piece are at right angles with each other. The hand piece is four inches long. At the outer end of the hand piece is a ball bearing which receives the outside thrust, or the inward thrust, of the instrument, so that any pressure brought to bear upon the instrument will not interfere with the power of the motor.

The chuck, which is a special one, is simple and effective, giving absolute rigidity and firmness to the instrument while in operation. The instruments are interchangeable in the universal chuck, and the instrument to be used by the operator can be quickly adjusted or released, as will be seen by a glance at the construction of the chuck. The motor, complete, weighs about four pounds.

Any surgeon who has had much experience with bone work appreciates the great difficulty of enlarging holes in bone with the ordinary hand reamer or chisel. In making holes for wiring bone, the electric drill is unsurpassed, as it penetrates without pressure.

The trephine found in this set is a new creation, and has no equal in efficiency. The guard and center pin are regulated by a thumb screw; the guard prevents the instrument from plunging into the cranial cavity. It can be set at any depth desired, by a simple movement of the finger.

In mastoid work it does away with the jarring and concussion caused by hammering, and prevents the possibility of puncturing or lacerating the coverings of the brain, not only in mastoid, but in other cranial work.

The electric saw will be found of great service in removing plaster casts, only one-tenth the time being required, as compared to the old method, and the operator is relieved of all work.

The cranial saw is simplicity itself, and is very effective in its work. It has a guard that dissects the dura from the skull, and at the same time protects the soft parts from being harmed by the saw. There is one special burr in the set (No. 5), which has a sharp point, and the cutters are cross-cut. This burr cuts with much more ease and much faster than the ordinary burrs.

The complete set consists of one motor, one sterilizer, two drills, two burrs, two saws, with mandrels, one trephine, and one cranial saw. The two saws that go with the set are both one and one-fourth inches in diameter, one having twice the set of the other.

This instrument was tried out by Dr. John B. Murphy of Chicago, during the Clinical Congress of the Surgeons of North America, November 13, 1913, and he stated as follows: "This is a first-class device, and by the use of this set of instruments—trephine, cranial saw, burr, and drills—we simplify and modernize bone surgery, also reducing the time and labor, both of which are essential factors in this important branch of work. The great power and efficiency of this small instrument, as a motor, saw, electric drill, reamer, and trephine, deserve the highest commendation of the profession."

# ANÆSTHESIA IN SURGICAL RESEARCH

## A Simple, Economical and Efficient Apparatus for Ordinary Routine Work

By BERNARD FRANCIS McGRATH, M. D., Mayo Clinic, Rochester, Minnesota

THE method herewith depicted and described contains nothing which is new in principle. It is presented for what it is worth, as a well tested, efficient, and comparatively inexpensive routine procedure. Anæsthesia is induced by means of a cabinet and continued with the apparatus shown in the figures. A rubber tracheal tube is attached to the horizontal limb of a three-way metal tube (Fig. 1). The latter contains within its lower limb an inlet valve, and an outlet valve within its upper limb. The former valve opens with inspiration to admit ether and closes with expiration; the latter closes with inspiration to exclude air and opens with expiration. The lower limb is enclosed in rubber tubing and inserted into the neck of a can of ether. A small opening is made in the top of the latter allowing a current through the ether vapor. In a side of the upright of the three-way tube is an opening for the admission of extra air. The amount of air is regulated by a perforated cuff. The three-way tube with its usual attachments may be sterilized. Some of the various combinations which may be effectively employed with the apparatus are shown in Figs. 2, 3 and 4.

*Application.* Under deep anæsthesia the jaws are separated, held apart with loops of strong tape, and the tongue is drawn forward with forceps. The laryngeal opening is made visible and easily accessible by means of gentle traction on a forceps lightly applied to the frænum of the

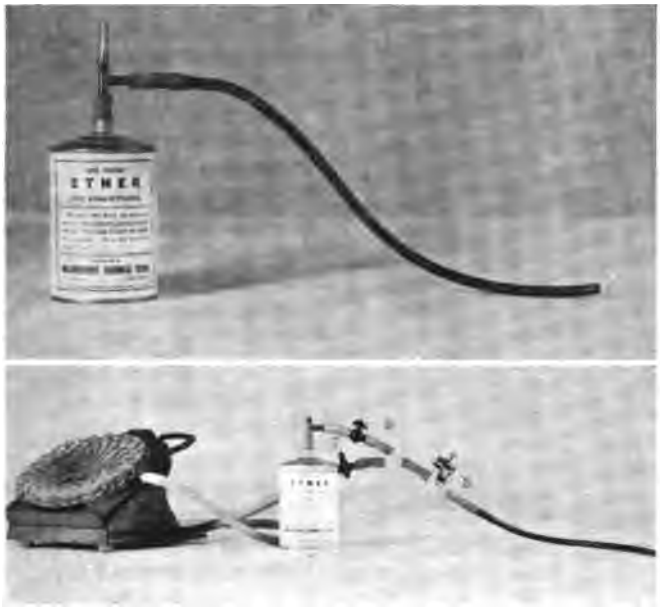



Fig. 1.
Fig. 3.

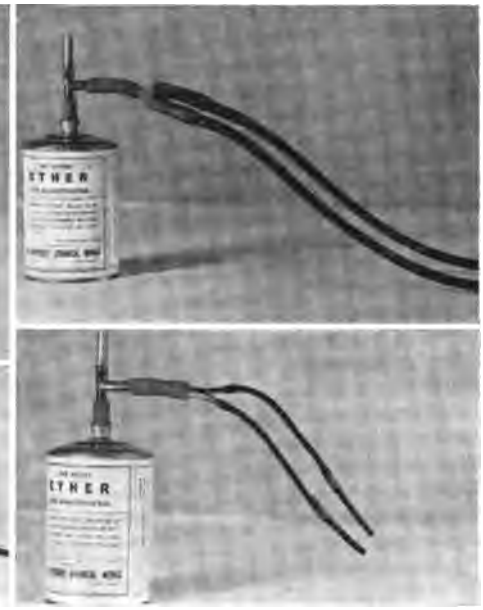



Fig. 2.
Fig. 4.

Fig. 1. (1) Location of *inlet* valve. (2) Location of *outlet* valve. (3) Opening and cuff for regulating extra air. (4) Tracheal tube.

Fig. 2. By removing the *inlet* valve and applying the arrangement shown in this figure, two animals can be anæsthetized with one apparatus. This has been successfully employed in twelve cases of transfusion.

Fig. 3. Foot bellows for insufflation, tube (5) for kymographic record of respirations, and regulating stopcocks (6 and 7) may be added to apparatus.

Fig. 4. Intranasal method. The mouth is closed to exclude air as far as possible, and absorbent cotton packed about the tubes in the nose. Commonly used before intratracheal method was adopted. The latter is preferable.

epiglottis. The tip of the tracheal tube is inserted into the opening of the larynx, the left index finger placed behind as a guide, and the tube now passed into the trachea.

The mouth is held closed with a piece of tape, and, if necessary, a small amount of absorbent cotton is placed in the anterior nares. There is usually sufficient space between two teeth for the tracheal tube. This apparatus has been used by the writer in more than two hundred cases. It is practically automatic, requiring but little attention, and, consequently, may be useful in the absence of adequate assistance or where equipment is limited.

---

# PITUITRIN IN INTESTINAL PARESIS FOLLOWING ABDOMINAL OPERATIONS

By O. H. STANLEY, A. B., M. D., Concord, New Hampshire
Assistant at Margaret Pillsbury General Hospital

PITUITRIN has been extensively used, recommended, and its results reported in obstetric practice. I have searched for literature giving definite results of its use in cases of intestinal paresis following abdominal operations in which there has been extensive manipulation of the viscera. The manufacturers include this condition in their list of indications for the use of pituitrin but furnish no definite statistics.

It has been frequently observed in obstetric practice that soon after its administration there is often micturition and sometimes defecation, but there is difficulty in stating whether these functions are caused by the action of the pituitrin or the pressure of the oncoming head.

However, I have noticed bowel movements following the injection of pituitrin, after the placenta was delivered. My purpose in reporting these three cases is merely an attempt to stimulate reports from other physicians who have had greater opportunity to observe effects of the drug.

Case 1. Female, age 19. Operation, double salpingectomy. Many adhesions were found in the pelvis involving a considerable area of intestine. Thirty-six hours after the operation she developed intestinal obstruction. Again the abdomen was opened and the adhesions causing the obstruction were broken. Both operations required much manipulation of the gut. A few hours following the second operation the patient's belly became greatly distended and all methods of obtaining expulsion of gas failed. The rectal tube was passed, suds enemas, high saline enemas and enemas of molasses, milk, and turpentine were given without result. Physostigmine, hypodermatically, failed to help. Hot turpentine stupes were applied to the abdomen. At this stage one cc. of pituitrin was given hypodermatically and repeated every hour. Before the second injection the patient expelled a small amount of gas. After the second injection she had a large fæcal movement and expelled a large amount of gas. Treatment was continued for six hours. Patient made an uneventful recovery.

Case 2. Male, age 24. Operated upon for appendicitis. The appendix was buried in a mass of old adhesions and required much manipulation to free it. Ten hours following the operation the abdomen became greatly distended with gas which did not respond to enemas. One cc. of pituitrin was given and fifteen minutes later the patient expelled a large amount of gas. After the second injection there was a fæcal movement. Only three injections were necessary.

Case 3. Woman, age 45. Operated on for ventral hernia following abdominal section for an ovarian cyst. There were many adhesions of the intestine to the parietal peritoneum. Fourteen hours after operation the bowel became greatly distended and injections of pituitrin were begun. After the third injection the patient began to expell gas and had no further difficulty.

It is evident that one must be sure that the intestine is not obstructed by firm adhesions or other abnormal growths. For this reason, it is advisable to begin the administration of pituitrin soon after the operation before adhesions have had time to become firm.

# TRANSACTIONS OF SOCIETIES

## CHICAGO SURGICAL SOCIETY

A REGULAR MEETING WAS HELD DECEMBER 5, 1913, WITH THE PRESIDENT, DR. M. L. HARRIS, IN THE CHAIR

DR. ADOLPH HARTUNG read a paper by invitation entitled "X-ray Findings in the Normal Stomach." (See p. 760.)

DR. HOLLIS E. POTTER read a paper by invitation entitled "Mechanical Factors in the X-ray Diagnosis of Pathologic Conditions of the Stomach."

DR. JAMES T. CASE read a paper by invitation entitled "The Röntgen Findings in Gastric and Duodenal Ulcer." (See p. 739.)

An invitation was extended to any visiting physician to take part in the discussion.

### DISCUSSION

DR. CHARLES SPENCER WILLIAMSON: I have been very much interested in the remarks that have been made by the various speakers and from the standpoint of an internist I can hardly expect to add anything of interest to what has been said. We internists have had some experience with the X-ray and with X-ray experts, and there are one or two things which it may not be out of place to discuss here. First, I was interested in the emphasis that Dr. Hartung placed on the whole subject of rugæ produced by pressure. It would seem simple to comprehend that when the stomach is filled with bismuth it would be in such a position and relation to the backbone as to cause apparent stenosis, or that other peculiar phenomena should exist. This has led in two or three different cases to erroneous diagnoses, the X-ray operator having taken, as he supposed, ample pains to do away with these pressure signs, and yet for all that in some way the backbone pressed against the stomach and produced signs which were attributed to carcinoma, etc., and in two cases it actually led to a diagnosis of carcinoma, and operation for that condition was undertaken.

With reference to poses, I am very much interested in the subject of enteroptosis and I want to call attention to one thing that has led sometimes to the clinician being held in disrepute by his X-ray colleagues where, as a matter of fact, he did not deserve to be. These are cases in which the old-time methods of determining the position of the stomach were resorted to. The method, I take it, most frequently used, is inflation by a double bulb, with air. When you try to determine the location of a patient's stomach by the method of inflation you do not get a correct silhouette. Let us stop to think of the conditions when we pump up a patient's stomach with air. Naturally, it is fairly taut, and then, with the patient in the erect or recumbent position, we percuss it out. The stomach takes on a cylindrical form, and what we percuss out is, not the silhouette, but that part in contact with the abdominal wall. Now, the portion below which is and cannot be percussed out appears, when the stomach is filled with bismuth, two inches lower than when we percussed it out. On two or three occasions the internist has been held in disrepute in determining the position of the stomach when, as a matter of fact, a difference in the method of percussion is what led to the apparent discrepancy. From my standpoint, as an internist, I find the röntgen ray a great help in the diagnosis of gastro-intestinal, especially in lesions of the œsophagus, which have been dwelt on fully, and it is in these conditions that I think the X-ray does something which can be done in no other way as well.

Again, in adhesions between the duodenum and gall-bladder and in adhesions about the pylorus it is very valuable. These are, as the internist knows, hard to differentiate because the symptoms are so vague and so general and they point towards several different organs rather than to the offending one. I can heartily agree with all that has been said as to the value of the X-ray and of the great necessity of having an expert to interpret the pictures.

So far as the diagnosis of ulcer of the stomach and carcinoma is concerned, I have had the opportunity to see two flecks from a large number of pictures I have had taken in which the trouble was thought to be due to gastric ulcer. One

case, the wife of a colleague from an adjoining state, and the other a patient in the city, showed these flecks beautifully. But that is a negligible quantity. These do not often lead toward a satisfactory diagnosis.

I have at the present time a case under my care in which, with a palpable tumor, I made a diagnosis of cancer of the stomach. My colleague, a very prominent surgeon, and I could not agree. A fluoroscopic examination was made by one of the most expert operators and nothing could be determined definitely, and yet carcinoma was staring us in the face. This patient bled profusely. Gastro-enterostomy showed carcinoma was present. The case shows that occasionally the findings interpreted by an expert X-ray operator may be perfectly negative. How to explain this I do not know and I must leave the explanation for those who know more about X-ray findings than myself.

I am one who adheres to the idea of Leube that there is only one way to determine the motility of the stomach satisfactorily. That other methods may be reasonably satisfactory I agree to; but after all is said and done, the patient is put in an abnormal condition when he takes a bismuth meal. I do not believe bismuth or any other similar meal is a normal substance on which to feed a patient. The general attitude of patients towards it is one of distinct repugnance. The way to determine the motility of the stomach is to give a good Christian meal and not a bismuth meal. Every clinician is aware of the fact that every now and then, when a patient is given a test breakfast or test meal, he knows a stomach pump is to be used in connection with it and as a result of the imaginary terror he experiences temporary stasis. It is the same way with the bismuth meal. I have seen quite a few cases where there was not the slightest suspicion of actual stasis, yet there was a condition of stasis due to nervousness. That is one of the inevitable errors of the method, and in my practice I have come to the point where I rarely give the regulation motor test meal. I have a patient eat an ordinary dinner and see whether the stomach is empty at the normal time. That gives a more correct reading of the motility of the stomach than can be gotten by the radiogram.

We confronted with the same proposition in regard to blood-pressure. We are all familiar with the fact that when a man comes into the office his pulse rate may be 115 and blood-pressure about 160, but as soon as the excitement has worn off his condition is different. This obtains to a lesser degree in the stomach than it does elsewhere, yet for all that it is not to be considered as a negligible factor. While we can learn much regarding the motility of the stomach after a bismuth meal, we are putting the patient in an entirely abnormal condition. We are doing what one author tried to do a number of years ago when he introduced the intragastric bag. When you have a patient who is pretty well trained it goes, but the first time you do it on any patient you find it is unsatisfactory.

I wish to conclude by expressing my great gratitude to röntgenologists for the great aid they give us in certain cases, and still we must not look upon the X-ray as an infallible diagnostic aid in cancer of the stomach. Many internists are at fault in expecting more from the method than can really be legitimately expected from it.

DR. ARTHUR DEAN BEVAN: I think we are all to be congratulated on having the opportunity of listening to the three papers that have been presented this evening. I want to take this opportunity to congratulate the men who gave us this privilege. Personally, I believe that the X-ray has been of a good deal of service in stomach work and that in the future it will be of very much greater service than it has been so far, because I regard it as being distinctly in the developmental stage. I think it gives us a splendid opportunity, if we all combine forces, of doing a good piece of clinical research work. This work needs to be done, not by men like Dr. Elliott, the internist, or by Dr. Case, or by Dr. Potter, or by Dr. Hartung, as a radiologist, or by Dr. Harris, or other surgeons, but this work should be accomplished by team work. It does not do at all for an X-ray man to stay in his laboratory and do the best X-ray work and go no further with it. It does not do at all for the internist to see his patients and make the most careful examination possible and go no further with it. It does not do at all for the surgeon to simply take these cases as they come to him without the aid of these other men and attempt to work out the problem himself. My conception of this problem I shall present to you. We have been doing a great deal of interesting work in the last few years along this line: I suppose my colleagues and I are doing possible a hundred stomach cases a year and these are done almost entirely in conjunction with the internal medical men, and of late, since this work has developed, in connection with the radiologist also I think this would be a mighty good suggestion for team work along this line; i. e., that the internist should take one of these problems and exhaust

all clinical means at his disposal, and then after he has obtained all the evidence that he is accustomed to handle in his way let him draw on a blank form the abdomen with the stomach, the pancreas, liver and gall-bladder in position; and let him outline his conception of the pathological anatomy, or what he believes to be the actual pathologic anatomy in that case, from his clinical findings; then let the radiologist do the same thing. Let him study the case very exhaustively and draw a picture of what he believes to be the pathologic findings in that particular case. We are actually doing this very largely in our own work. If a case comes to operation, or, as a few of them do, to post-mortem examination, the exact pathologic findings can be determined by the surgeon or pathologist. In that way we shall be in a position to unravel many of the problems that are so far pretty knotty ones and difficult ones, and I would suggest that when the surgeon operates on these cases the radiologist be present at the operation so that he can actually see for himself and have a mental conception of the pathologist anatomy in that particular case and check it up with the X-ray findings. Certainly the internist should be at the operation, as he usually is, and see the same findings. There is one thing I should like to suggest to these röntgenologic in connection with the evidence that they must submit to the internist and to the surgeon, and it is this: I am sure their screen work is excellent, of definite value, and indispensable, but the radiologists must bring to the internist and surgeon some evidence, definite, concrete, that the surgeon and internist can study, not in a dark room but in the light; in other words, study the case with the X-ray, with the screen work, as thoroughly and definitely as you can, but you will have to submit to the internist and surgeon a series of plates of what you believe to be the local evidence in that particular case. I feel confident that a good deal of bad work has been done with the X-ray, not only in this particular field but in other fields. At the present time I have many a patient sent to me with a bismuth picture and with a request to stitch up the transverse colon or to take a reef in the stomach, or make an anastomosis between the ileum and sigmoid simply on the X-ray evidence. That is not the sort of work that Dr. Case, Dr. Potter, and Dr. Hartung are doing, but it is the kind of ignorant half-baked work that is done by men with little experience in X-ray work, and these cases are operated on by men with little experience in surgical work. It belongs to such a society at this, and with just such a union of forces as we can bring together, to place this work on a sound useful basis and develop out of it the great possibilities that it is certainly capable of giving.

I want to relate briefly the history and show the autopsy specimen of a case of jejunal ulcer following a gastro-enterostomy with adhesions and perforation into the transverse colon. Dr. Case will show the X-ray findings which were obtained before perforation into the colon had occurred.

Patient, male; age 55; entered the service of Dr. Bevan at the Presbyterian Hospital, 1910, with ulcer symptoms of ten years' standing. He had been treated medically three times with only temporary relief. He was operated on and a duodenal ulcer was found. Posterior gastro-enterostomy was performed. Patient was entirely relieved for a period of nine months when symptoms of the ulcer returned and have continued ever since. He was treated medically for three months in the summer of 1911 and kept himself fairly comfortable most of the time by careful dieting and the use of alkalies between meals.

The X-ray examination by Dr. Case was made in 1911. Two months ago the patient was taken suddenly with pain in the abdomen, some nausea and vomiting, and was confined to his bed for ten days. Since then his ulcer symptoms have been worse. There has been a great deal of belching and flatus. The breath has been foul. There has been frequent nausea and vomiting. No history of undigested food in the stools nor of having vomited fæces. Stomach analysis showed continuous secretion with acidity ranging around 70 and no fæces. Stool analysis showed occult blood occasionally, but no undigested food. No X-ray examination was made.

A diagnosis of recurrent ulcer, location uncertain, was made, and a second operation was performed. On opening the abdomen the transverse colon was found adherent at the seat of the gastro-enterostomy and the anastomosis admitted a finger when invaginated from the stomach into the jejunum. No ulcer could be found anywhere. The duodenum was closed by crushing, ligating with catgut and surrounding the seat of ligation with a strip of fascia from the sheath of the rectus. A half-hour before the operation the patient passed a stomach tube and washed out his stomach, a thing which he was accustomed to doing. After recovering from the anæsthetic he developed pain in the upper part of the abdomen, chest and back. The pulse became rapid and weak and frequent vomiting set in and he died at the end of twenty hours. At autopsy the caused of death was found to be a perforation of the apparently healthy œsophagus 2 cm. above the cardia, with hæmorrhage into and infection of the mediastinum. No scars nor ulcers were found in the stomach. There was a scar from a healed ulcer on the superior wall of the duodenum just beyond the pylorus. Transverse colon was adherent to the jejunum, at the seat of the gastro-enterostomy. Upon opening the jejunum a punched-out ulcer the size of a twenty-five-cent piece with moderately indurated walls was found on the anterior wall of the jejunum beginning 1 cm. below the gastro-enterostomy ring. The colon was adherent over the ulcer and extending off from one margin there was a perforation into it, almost as large as the gastro-enterostomy opening. The finger could readily be carried from the stomach into the jejunum and out into the colon.

Ulcer of the jejunum following gastro-enterostomy is now recognized to occur in about 1 per

cent of the cases, and of the more than 150 reported cases that have been confirmed at autopsy or operation about twenty-five have perforated into the transverse colon. This is the third case which I have seen at autopsy and in all three there was a perforation into the colon. In one case eleven years after operation the jejunal ulcer had healed leaving only the jejuno-colic fistula. All of the colic fistulæ have formed in cases where the posterior anastomosis had been made either by the Y or the ordinary method. Several of these cases have been diagnosed and the X-ray findings have been of great service. Bismuth by mouth may be seen in a short time passing over into the left half of the transverse colon, while bismuth per rectum soon passes into the stomach. The immediate cause of death was as unusual as the complicated ulcer findings.

---

## CHICAGO SURGICAL SOCIETY

A Regular Meeting was held February 6, 1914, with the President, Dr. M. L. Harris, in the Chair

Dr. Emil G. Beck read a paper entitled "Present Status of Joint Diseases and Their Best Treatment." (See p. 757.)

Dr. Frederick G. Dyas read a paper entitled, "Streptococcic Infections with Special Reference to Arthritis and Its Treatment." (See p. 734.)

These two papers were discussed together.

### DISCUSSION

Dr. A. J. Ochsner: Dr. Beck's enormous experience is certainly very valuable, and ever since his demonstration of the first case we have followed the methods that he has described from time to time. I found it was not very easy to follow the exact directions, however, and in a few cases in which we used a 25 per cent mixture of bismuth and vaseline there was some degree of bismuth poisoning. We also had one fatal case.

I think it is very important in these cases of cold abscesses to use weak solutions.

There is one point that Dr. Beck has spoken of frequently which almost no one seems to remember. Surgeons frequently do not get very good results where there are several sinuses on account of a faulty method of injecting them. Some of these patients have several sinuses as seen in one of the patients exhibited this evening. Dr. Beck tells us to inject the bismuth paste slowly into one sinus until it begins to escape from one of the others. Then he places his finger upon the other sinus and keeps on injecting slowly until it escapes from a third one, then closes that and lets it come out of the fourth, etc. Since we have followed this plan our cases have recovered as smoothly as those of Dr. Beck, but before that they did not.

In the rather acute tubercular infections in knee-joints, especially in children, I have in a good many cases disinfected the skin thoroughly, and made an incision on the external and one on the internal aspect, then applied a large boric acid and alcohol dressing, made extension, put the leg in a plaster cast, and in quite a considerable number of these cases I have had perfect motion afterwards. I would not advise anybody to use this method until I have had about one hundred cases more, but so far I have not had any bad results with them. They have done wonderfully well, and I have had beautiful results. I simply mention this without urging anyone to follow the method, but until we have a bad result in one of these cases I shall continue to use it.

The paper of Dr. Dyas is very interesting and instructive.

Dr. Beck (closing): I am glad the subject of bismuth poisoning was brought up by Dr. Ochsner. Although I have it in my paper I did not speak of it. In over twelve hundred cases treated with bismuth paste in the practice of my brothers and myself, we have not had a fatal case because we have been exceedingly careful. I have a case now in which the patient barely escaped having bismuth poisoning; it is a case of empyema. As soon as I discovered the signs of intoxication I washed out the paste with olive oil, and all symptoms disappeared.

While in St. Louis about two months ago I was informed by a prominent surgeon there that he had a case of bismuth poisoning. I went with him to the hospital and saw a case of severe intoxication. This was a case in which there had been a psoas abscess, into which the doctor had injected about eight ounces of the paste and

"left the bismuth in." He showed me a picture, and I asked him what percentage of bismuth he had used, and he replied, "Just what you prescribed." From the density of the shadow I could judge that instead of a 10 per cent mixture, a much stronger mixture had been used, and furthermore, the paste had been left in the cavity. This was a mistake. We immediately opened the abscess and washed the paste out with oil. Subsequently I received a note from this surgeon in which he expressed his gratification at the disappearance of all symptoms of bismuth poisoning. I believe that patient would have died if we had not promptly done the right thing, as only mouth washes were being given by the internes.

I have here a young man who for twenty years has had hip-disease with eight sinuses. He has a rectal fistula resulting from the hip-joint disease. I here show a stereoscopic radiograph of his case, which is rare and most instructive. He has no ischium on one side; it was all destroyed by the disease. You note that the paste passes from the hip-joint through the abdomen to the rectum. The other openings are all around the hip-joint. He has improved considerably since receiving the injections.

There is one point I wish to allude to which may interest you. I want to explain why all these patients gain so much in weight. Here is a patient who weighs ten pounds more than he has ever weighed in his life. Many of these cases gain in weight out of proportion to their previous normal weight. How can we explain a gain of two or three pounds a day for one or two weeks. I have had some of these patients gain fifty and sixty pounds. I have a theory that I have advanced, and it is this (illustrating on the blackboard by diagrams): When a chronic disease like tuberculosis develops it simultaneously produces a corresponding degree of immunity. The longer the disease lasts and the more organs are affected, the greater will be the degree of immunity. In other words, the immunity tries to keep pace with the progress of the disease. If a man has tuberculosis of the testis, kidney, and bladder, each disease-producing area will produce its proportion of immunizing substances. Let us present this in figures. Let us suppose a man has ten units of the disease in the kidney, five in the bladder, and ten in the lung, a total of twenty-five. He has already developed an immunity of eight from the kidney, three from the bladder, and seven from the lung. He is shy two, two and three, correspondingly. He needs an immunity of twenty-five. As soon as the units of immunity overreach the units of representing the disease-producing areas or toxines from them, spontaneous cure takes place, such as you find in thousands of cases of tuberculosis of the lung. This margin of needed immunity can be produced artificially by fresh air, vaccines, sunlight, and by different treatments. But what we are doing is something different. We reduce the disease-producing area. If we remove the man's kidney, he has left a disease producing area of only about fifteen, and the existing immunity of eighteen is sufficient to take care of all the remaining disease in other parts of the body. If you remove a tuberculous kidney from a patient having a coexisting tuberculous bladder, the tuberculosis of the bladder gets well without any treatment, although previous to this time you may have tried everything without effect. These hip-joint cases are similar in nature. I have treated cases of hip-joint tuberculosis in patients who have had pulmonary tuberculosis as well, and yet by treating the hip-joint disease the pulmonary condition has cleared up without any other treatment. I have statistics of my cases and of experiments on animals bearing on this, and some day I will publish them to prove my contention.

One patient for whom I removed a tuberculous testicle, recovered from a pulmonary tuberculosis which existed at the time. As stated, I have made extensive experiments on animals, but have not had the time to work them out completely.

DR. A. J. OCHSNER: While I was in Professor Albert's clinic in Vienna twenty-seven years ago, he showed us case after case in which there was pulmonary tuberculosis and tuberculosis mostly of the ankle-joints. He would say that "if we amputate in this case, the patient will get well, but if we do not amputate and resect the tuberculous joint, the patient is likely to die." He did not give any explanation for saying this: it was simply his experience in many cases.

DR. FREDERIC A. BESLEY: I wish to express my appreciation of the paper of Dr. Dyas, which was most instructive to all of us, and he deserves great credit for the type of work he has been doing. I believe this is another bit of evidence as to the fallacy of all antiseptics used in this way. I believe it teaches again that antiseptics used in joints or used on any surface are not capable of producing any germicidal effects on the organisms that are really doing the destructive work. These organisms are not on the surface, but in the surrounding tissues, in the lymphatics; and it

is impossible to use a germicide strong enough or powerful enough to in anyway inhibit the action or destroy the organisms without destroying the tissue.

His deductions as to iodoform and formalin reducing the resistance of the tissue of the joints to infection are most logical and timely.

DR. CHARLES DAVISON read a paper entitled "Treatment of Fractures by Medullary Bone Splints." (See p. 750.)

## CHICAGO GYNECOLOGICAL SOCIETY

A REGULAR MEETING WAS HELD JANUARY 16, 1914, WITH THE PRESIDENT, DR. FRANK W. LYNCH, IN THE CHAIR

DR. EUGENE CARY (by invitation) read a paper entitled "Death of a Full Term Fœtus due to Constriction of the Umbilical Cord by Amniotic Bands; Rupture of the Amnion; Hydramnios." (See p. 730.)

DISCUSSION

DR. CHARLES E. PADDOCK: The report of the case by Dr. Cary brings up the subject of antenatal pathology, a subject of so much interest and yet so little known. Ballantyne of Edinburgh has probably given us more enlightenment upon this important study than any one. Several journals have been established, devoted entirely to subjects of antenatal pathology, but for lack of patronage these journals survived but a short time. The numerous articles, however, presented showed a widespread interest in the subject. I cannot say that cases such as the speaker has presented are rare. Personally, I have not had or seen one just like it. Of course, I have seen amputations and skin-lesions said to be the result of amniotic bands or adhesions in the early pregnancy. And, as I understand it, amniotic bands and adhesions, due to the amnion, belong to the neofœtal period and not the fœtal period; that is, they belong to teratology, rather than fœtal pathology. This case, then, is unique in that according to the speaker the amnion ruptured late, due to a hydramnios, and that later these amniotic bands so constricted the umbilical cord as to shut off the circulation and destroy the child.

DR. RUDOLPH W. HOLMES: The statement has been made that a band ruptured the membrane and the amniotic fluid gradually worked its way between the membrane and the amnion and chorion and separated it *in toto*. I do not think that had any bearing on the case at all. Usually rupture of the amnion — or more commonly as we see it, rupture of the chorion — may take place because occasionally there is no coalescence whatever of the amnion and chorion; and the chorion for some reason or other may rupture with the amniotic sac, and rupture of the chorion occasionally is accompanied with the escape of a considerable amount of fluid. I think there was failure of coalescence of the amnion and chorion in this case, and the baby's leg or arm might have been caught by that band, and the amnion was weak enough to permit it to be torn, when it gradually floated until it gathered up around the placenta.

DR. FRANK W. LYNCH: A paper like this is very timely in calling our attention to certain points which do not seem to be very well understood by men who have not devoted much time to this branch of medicine. Within the last few days there was a paper read at one of the special societies in town based upon some experimental work concerning fœtal movements in asphyxia. I think that sometimes we lay ourselves open to criticism of such work as has been done by Ahlfeld and his followers from Marburg way back in the eighties, because cases of this type have not been reported. I recall what a shock it was to me when I first appreciated that my lot was to be able to tell pathologic fœtuses and ova, at a time when some of us were very lucky to be able to tell that they were ova, and that they were pathologic due to deformity of amnion. I would like to ask Dr. Cary whether sections were made from the constricting band.

DR. CARY: . No.

DR. LYNCH (resuming): This case must be unique if the literature fails to give a like example. Mention should be made of the work which Ballantyne did in his antenatal pathology and the spasmodic attempts that came out of Bohemia of work on this line in the causation of pathologic formations.

DR. PADDOCK: In 1856, G. Braun reported a case of this kind. Whether it reached term or not I do not know, but the case was published in a

French Medical Journal and in the German Journals.

DR. CARY: I have quoted that case in my paper, and it is the nearest in nature to the one I had.

DR. FRANK CARY: I want to make one or two remarks in connection with this case. If these amniotic bands were of long duration, lying free in the cavity, the amnion removed from the chorion, I do not believe if they had been strong firm bands they would have broken. They were recent bands or they would not have been in that condition. I may be wrong in my supposition, but that is the way it strikes me. If the literature is correct, if this amnion had been long ruptured, the fringe of amnion left would not have been in that condition. It would have been in the condition of being curled up and more or less disintegrated. This amnion was not so disintegrated, and that is why I believe it was of recent date.

DR. EUGENE CARY: Dr. Paddock spoke first of these bands being arranged more like adhesions, and that is the point I want to bring out. You can get more literature on amniotic adhesions than you can cart off in an express wagon, so I purposely side-tracked that part of the discussion altogether. Then he asked, Why did not the amnion rupture early, and was this merely a late result? The question can be answered in several ways. First of all, these bands when the child was born were entirely free and tied around the cord, but, as Dr. Frank Cary stated, these bands were formed of firm tissue and the amnion that was left around the cord was perfectly free and was not thickened or changed in any way, except having been torn. That, with the literature behind it, means a great deal because in all the cases reported, some twelve in number, the amnion was all rolled up excepting in the case reported by G. Braun in 1856. Lovedale goes further and states that in these cases where the amnion has ruptured early the chorion becomes very much inflamed and changed, so that it cannot in some cases be stripped off the lining of the uterus. The inflammation becomes so great you cannot get it all off with a curette, and the placental membranes are delivered intact without being torn, without anything left behind, and the placenta was delivered spontaneously. Dr. Lynch speaks of asphyxia in these cases. If this woman had been in the hospital and watched at the time this severe constriction of the cord occurred, the baby with severe infection might have been saved. Jones, in one of the British journals, has written an article on the same subject in which he mentions constriction of the cord in a twin pregnancy where there was excessive movement of the twins and then all life ceased, and on delivery he found the cords of the twins had been twisted in such a way that death resulted. I wish to thank Dr. Franklin for translating the Russian article for me. I spent three months off and on going over all the literature. I went back as far as '61, followed the different clews and asked different men who were interested in this particular branch regarding these cases, and I have not found any cases similar to this one, except the one by G. Braun in which the amnion ruptured late and where there was constriction of the cord by amniotic bands.

DR. CHARLES S. BACON: In connection with the remarks of Dr. Lynch and the closing remarks of Dr. Cary, I wish to suggest the possibility of diagnosing danger to the child *in utero* and the possibility of timely interference. The part of the report that dealt with that interested me very much. Within the last ten days I have had the case of a woman who had lost two children previously, one having died *in utero* a few days before term.

On account of the history I had the woman go to the hospital about ten or twelve days before labor was expected and had her watched carefully. I had the fœtal heart tones counted at regular intervals every two or three hours day and night. We found a variation in the heart tones of between 135 and 164. At the time when the child's movements were excessive, the woman was having considerable distress; the heart tones were unusually rapid. The regular heart tones we had previously determined to be 140. On account of the history and the fact that she had a cross presentation with breech below, I made a cæsarean section nearly one week before the expected delivery of the child. I found a rather unusual condition. We had a very large placenta which was bipartite. The cord came off between the two sections of the placenta, but whether this had anything to do with the condition I do not know. However, the practical bearing on the subject is interesting.

If it is possible in these cases of antepartum death of the child to diagnose this condition by the heart tones we may save some of these children. Just how much variation there is in the heart tones I do not know. I have not had time to look the matter up and see whether extensive observations have been made on the subject. Since this subject came to my attention a few weeks ago I have taken occasion to count the heart tones in a number of cases, and have found there is not much variation in those cases I have examined.

DR. HOLMES: What caused the variation in the heart tones? Was the child endangered when you got through with the cæsarean section?

DR. BACON: The child was not asphyxiated. It is apparently a healthy child. The placenta was extremely large: it nearly filled the whole

uterus. This led to considerable difficulty in getting the uterus to contract.

DR. HOLMES: It has been a common observation of mine that there is considerable variation in the heart tones. For instance, a woman will come into the office and when you first count the heart rate it will be one hundred twenty; you may palpate the baby and press the head and see how firm it is fixed in the brim, and if you count the heart again it will be 150, 160, or 170.

DR. EUGENE CARY (closing): Referring to the case related by Dr. Bacon I have had a case somewhat similar to it. The placenta, instead of being one piece, was in two halves.

I had a case about a year ago where I was called out at three o'clock in the morning to see a woman who was reported to have had a severe uterine hæmorrhage about an hour after the onset of labor. This day she had passed over a quart of blood up to the time they telephoned, so I hurried out there and saw the woman, who previously had had a fairly large abdomen and apparently a condition of hydramnios. She was apparently in labor and in good shape, and I did not examine for the fœtal heart tones, because the bag of waters had ruptured and the fœtal heart tones were in good condition, and I did not believe she had this enormous hæmorrhage. I was finally convinced by seeing that it was not all blood but water mixed with it. It was tinged with amniotic fluid. So I was quite at a loss to know where all the blood came from without continuing. There was no placenta prævia or suggestion of one. The baby was delivered, was perfectly healthy, and all right, and then we delivered the placenta and made an examination to see where the hæmorrhage had come from, and in carefully examining the placenta it was similar to the one Dr. Bacon described. In this case there was a large mass of placental tissue on the right side, and on the left side there was a mass about one-half that size. The blood-vessels ran out into the membranes and from there up to the cord. When the labor pains started the contractions began to stretch the membranes, the cervix was effaced, the os dilated, and the stretching was put upon the blood-vessels, and luckily for the child the membranes ruptured. One of the vessels between the cord was torn clear across, both ends were contracted, and that vessel was bleeding and giving all this hæmorrhage. As long as the amniotic sac held intact the blood was forced in the amniotic fluid, but as soon as the sac ruptured the water rushed out, the uterus contracted down, the fœtal head pressed against the broken vessel, every particle of hæmorrhage ceased, labor went on normally, and the child was delivered.

Dr. William Cuthbertson by invitation read a paper entitled "An Improved Gilliam Operation for Uterine Displacements" (See p. 721).

DISCUSSION

DR. ALBERT GOLDSPOHN: I had thought that this subject was quite exhausted without having an additional modification of the transplantation of the round ligaments in the abdominal wall; yet other men have a right to their opinions, and if we are to have one more modified operation, all right, as long as the fundamental principle that governs all these operations is correct; viz., that you deal with the thick end of the round ligament to do service, and not make the mistake that is made in the Baldy-Webster operation, and that of Dr. Ries, whose technique is anatomically wrong because it places dependence upon the terminal, useless, outer end of the round ligament to do good or to hold; and this it can not do.

Practically all men except a few general surgeons like Dr. Coffey are agreed that the round ligament is the thing that we can rationally use and depend upon, and the argument of some of the pettifoggers to the effect that the round ligament does not serve to hold the uterus forward is a weak one. We do know that it does something in that direction, but how much we do not know; and I do not care. If the round ligament up to the time of the operation has had no function, there is nothing at all in opposition to my giving it a function. It will give good service. That, all the gentlemen know who deal with the round ligament in the right way. There are a dozen different ways of making an efficient transplantation of the median useful end of the round ligament into the abdominal wall. The Montgomery, Noble, Barrett, and many other modifications of the Gilliam operation are all correct, in my judgment, in that they make use of the thick end, the uterine part only of the round ligament to do service. They make it serve by changing its course and securing a new attachment for it and ignore the outer end. In the main these operations are all of a substantial character; but there are differences. They are not all equally applicable to various kinds of cases. For instance, if you want to do the operation of my friend here, Dr. Barrett, on a patient who has had a severe pelvic peritonitis, if the broad ligaments and round ligaments are thoroughly infiltrated, and you want to separate or isolate the round ligament to such an extent as is necessary to draw the loop as far laterally as the location of the internal abdominal ring, and from there out in the abdominal wall, you will not be able to do it; and this he has admitted himself. But it is a different thing if you simply pick up enough of a loop to pass directly straight forward through a blunt puncture, not as far as Dr. Cuthbertson goes, but say about an inch laterally, from the median incision, through the rectus muscle and aponeurosis and anchor it in these firmer structures. This can nearly always be done. Dr. Cuthbertson proposes to make the attachment to the aponeurosis of the external oblique, which is much weaker and in some women will be a rather delicate thing. Some objections have been made to the

idea of stab in the abdominal wall to pass such a structure through. It requires nothing of the kind. There is no stabbing done. We can take a slender artery forceps and pass it through about the middle of the sheath of the rectus, through the aponeurosis, muscle and structures within, and draw the round ligament through, with the same slender forceps after having previously isolated a loop within, and without any intervening loop or strip of gauze or ligature whatever, simply from one forceps to another upward and outward. As the years have gone by and the hundreds of cases have multiplied that have been subjected to this procedure, I have grown to have this feeling, that it is the argument of a pettifogger to say that the uterus is strictly a pelvic organ, that it should not be drawn out of the small pelvis, that it does not belong in the abdomen, and that it has no business being near to the abdominal wall. I can refute such an argument by reporting hundreds of cases. I have this feeling now as the result of what I consider mature experience, namely, with about 100 cases yearly for at least ten years in which I have performed this modified Gilliam operation almost alone. I find that the higher the ovaries are drawn out of the small pelvis the better is the return current of venous blood, and the more subjectively comfortable is the patient. The idea of being afraid to draw the fundus uteri out of the pelvis, and approximating it to the lower part of the abdominal wall an inch and one-half or two inches from the border of the symphysis pubis, is erroneous. It is a mistake to go much higher than that. I would not make these punctures through the recti over two inches away from the symphysis, often less; and the method of drawing up the loop of round ligament occludes the part of the peritoneal cavity below that point crosswise from entrance of intestine into it thereafter. The lateral portion of the round ligament is drawn up so snugly that it effectively occludes the space laterally from the point of anchorage on each side, and the fundus uteri closes the median space. It is my belief that the intestine does not enter the lower inch and one-half of peritoneal space. Such a thing as interference with the intestine or intestinal obstruction, I have seen once only. This was about fifteen years ago when I first tried this operation. I was afraid to draw the uterus up high enough, and a knuckle of intestine probably worked down between the fundus and abdominal wall; and later the patient had symptoms of intestinal obstruction. These disappeared, however, without surgical intervention. This is the only case of the kind I ever saw. We should properly open the abdomen to cure retroversion; because we have so many other important things to do for these cases. It is our duty to remove the appendix in practically every one of them. Such cases admit of the removal of the appendix every time. Howard Kelly was very correct when he said fifteen or twenty years ago that after the abdomen has once been opened and surgery has been done in the vicinity of the appendix, it is thereafter in greater danger of making trouble on account of adhesions to which it is apt to become subjected. Therefore, when we open the abdomen and attend to this minor retroversion work, we should make an incision—or more than one—that will give us access for every other surgical act that may be called for in that abdomen. I think this intensified Gilliam operation, which secures the uterus and its adnexæ on a higher plane and in pronounced anteversion, is the best. Aside from my favorite bi-inguinal operation of past years, I have not discovered any procedure that will secure as much comfort as well as stable and innocent results for the patient. It can be done quickly leaving the greatest possible time for work in the upper abdomen. You can put your hand up there and if there is anything that is suspicious you can make a second incision, and do what is necessary to be done.

DR. THEODORE J. DOEDERLIN: I was prompted by the writings of Dr. Howard Kelly in the early part of my practice to apply ventrosuspension and ventrofixation. He was my authority then, and so far as I was able to follow up the cases I never had any untoward results, but I invariably resorted to the anterior operation. I did not turn the uterus out, but sewed it to the posterior part. I had one woman who was confined twice after that, and she never had any trouble. Later I abandoned that method and for the last five or six years I have been doing the Gilliam operation. I have had six or seven cases, mostly private cases, which I have had occasion to follow up and the results were all good except in one. That was the first case I operated on, which was one of extensive puerperal or post-partum inflammation, the patient having come to me from out of town, and in that case there was a recurrence. The uterus fell back. Since then I have not had any recurrences, but have had a partial slipping in one case and that I attributed to the catgut I used. I sewed around through the aponeurosis to the outside with three sutures, and I thought it was safe. I never gave it any thought. Since the partial slipping back I have used the Pfannenstiel incision, and run that through, first

entering the aponeurosis, going through the round ligament and tying it over a piece of gauze, feeling I was safe, and with the silkworm-gut suture tied the round ligament, taking the suture out after ninety days.

I would like to congratulate Dr. Cuthbertson on his ingenious operation. Speaking of the Baldy-Webster operation, I do not think I need to emphasize at all that there are two reasons to my mind which speak against it. In the first place, it shortens the thick or strong part of the ligament; in the second place, there is constriction of the uterus. A friend of mine had a case where the uterus tipped up and there was a retroflexion carrying the round ligaments backwards. There is very little or no danger to the perineum, as I sew the aponeurosis together with my extra stitch. To avoid strangulation I now use iodine applied to the part which runs from the internal ring to the stab, so that there will be adhesion formed. I never had a chance to investigate whether it was properly adherent or not, or whether there would not be a hernia at that place. I have never seen Dr. Goldspohn operate very much; he is an expert in the method he has described, but in my humble opinion in drawing up the uterus as he does there is too much tension on the ligaments, which is hardly advisable, so that the uterus is crowded naturally to the front, and we may get ventrosuspension. The top of the womb will be adherent to the incision. With the Pfannenstiel incision you can make a cross section of the aponeurosis. He does not do that, but makes a nipple there which is nice for his special way of operating.

DR. CHANNING W. BARRETT: The probabilities are that every person here, except Mr. Whitford, who has reported so many discussions on this subject, is perfectly satisfied as to what operation he will do for retrodisplacements of the uterus; otherwise, if he were to operate to-morrow he would be considerably confused from all he has heard upon this subject to-night. A paper of this kind is chiefly valuable because it gives an opportunity to deal with principles and compare methods. The principles of support are that we want the uterus held forward, not that the much doubted intra-abdominal pressure will fall upon the posterior surface of the uterus, but nature has decreed that animals in the upright position should not have the uterus in line with the vagina, and the vagina longitudinal with the body. Every once in a while we hear a person sneer at the idea of the round ligaments holding the uterus forward, and yet they forget that nature said that, and nature has said it over and over again until it grew a round ligament for the upright animal, the round ligament being a structure developed in upright animals, and that it is for the purpose of dragging the fundus forward. We do not have to indulge in any more talk about the value of the round ligament to hold the uterus forward. The question largely is this: How shall the round ligament be used when it has once become stretched and the uterus got back in line with the vagina? Shall we use the stronger or weaker part of the ligament, inasmuch as one is stronger than the other? Some have said the poor part of the ligament is plenty good enough. When they say a thing is good enough it is abundant evidence it is *not* good enough. There is nothing that nature has made that is good enough at all times, and there is nothing in surgery that we can do that is good enough if it can be done better, and so we should use the strong part of the ligament if we can, and not the weak part. I believe in the main with what Dr. Goldspohn has said. I believe more fully in what he said when he talked about the principles of this work of dealing with the round ligament through the internal ring. He taught principles that are fundamental and important, but he has departed from those principles somewhat in his later years. He has gone wrong somehow. That is one of the chief arguments against the old operation of ventrosuspension in favor of bi-inguinal celiotomy, of having the ligament run through the abdomen transperitoneally, and yet the operation he proposes or follows, following the Gilliam, is to run the two ligaments through the peritoneal space around which omentum or intestine can become entangled. We not only want to use the round ligament to hold the uterus forward, and the very best part of the ligament, but we want it placed so it will be in a normal position. They should not run through the peritoneal space and furnish opportunities, as the Gilliam does, to entangle bowel. And so, following the principles which Goldspohn and others have laid down, I devised a procedure of coming out through the abdominal wall to the ring, bringing the ligaments out at the place they normally come out of the abdomen, so that there is no opportunity for bowel to become entangled around them. It is a fundamental principle that no structure should run transperitoneally.

As regards this modification by Dr. Cuthbertson, when Gilliam first proposed his operation a good many of us thought it was the best operation offered the profession up to that time, and I performed it for a few years, and I never knew a single one of these cases have the ligament slip out. I

have never known one of these patients to return after the operation was performed on account of a recurrence of the displacement, but I have seen conditions that were pathologic from that procedure. The doctor spoke of the operation which I have devised as furnishing an opportunity for the ligaments to become loosened and to slip. I have performed that operation for ten years, and I have never known a single case in which I thought the ligament gave way, and went back into the abdomen. Dr. Goldspohn usually in discussing this lays some stress upon the trauma the operation produces. From the standpoint of trauma we have in mind two things. While once in a while we will have a hæmatoma by coming out at the external ring and bringing the ligament through the internal ring, and once in a while we will have a hernia, I must say that in ten years not a single hernia or hæmatoma has occurred. When I read a paper nine years ago on this subject and Dr. Goldspohn discussed it, he said it was theory. It is a fact, now, that we do not have these things occur; so that whether one choses for the operation opposing ligaments, which is the method which furnishes greater trauma and produces more injury to tissue and necessitates greater work, or whether we simply do the method of fastening as Gilliam has proposed, I do not see that there is any great point here, because the ligament has not given way. In regard to the incision, if we examine the charts of Dr. Cuthbertson and we are to judge from the size of the ligaments shown, the size of the longitudinal incision, the size of the forceps, etc., this is minimized from the normal size, and yet if that incision is equally minimized, I should hardly suggest that as a method of operating for retrodisplacements of the uterus.

Dr. N. S. Heaney: Dr. Goldspohn spoke about one case in which he had strangulation in the lateral loop of round ligament but which did not require operation. I would like to know how he made the diagnosis of strangulation of the gut through the lateral loop.

Dr. Channing W. Barrett: Reference was made to the point that in cases of infiltration the ligament cannot be taken out through the ring. I have always taught that the procedure of shortening the round ligament in that way could not be done in cases of infiltration, and I observed that precaution in doing the Gilliam operation, and I should likewise observe it if I were going to do the Gilliam operation at the present time. The Gilliam operation, or the shortening of the round ligament through the ring, is not at all fitted for those cases that have infiltration and a mild sepsis such as he speaks of. Neither one of these procedures should be done in such a case.

Dr. Albert Goldspohn: Dr. Barrett did not listen to what I said. There is practically no space left in front of the uterus between it and the bladder. I have had occasion to open up some of these women again for other pathologic conditions, and I am prepared to say that the intestine does not enter below my approximation to the abdominal wall. If that is true there is no such thing as "snarling by the two ligaments," because the intestines do not pass below or around them. Nor will the fundus uteri become adherent to the abdominal wall merely from contact with it, if we do clean surgery. In the matter of infiltration of the round ligaments, I should be very sorry if I had to back down, and forego the use of the round ligaments entirely because of such infiltration; for only some barbarous fixation then would remain available. Not so with my use of the round ligaments, for they still serve best even in the borderline cases in which the most extreme use of conservative surgery on the adnexæ is made use of to save or to restore a small prospect for conception. In these cases, a ligament will occasionally tear off. An Olshausen fixation of the cornu is then made. The round ligaments must not be dissected out from their peritoneal envelope; but this—i.e., the upper part of the broad ligament—must be freely made use of with the round ligament in order to close off the lower part of the abdominal space as above described, and to secure stable results.

Dr. Heaney: You have not answered my question.

Dr. Goldspohn: In the first place it was something like ten days after the operation when the patient had intestinal obstruction. There was no doubt about that, and there might be a question whether the passage of the bowel had occurred in the median line between the fundus and abdominal wall, or whether it had occurred in one of the lateral portions over a round ligament. But in those days I was afraid to draw the uterus up as much as I do now, and there was more space between the fundus in the median line than there was laterally. Any one could see that by the way we draw the loops up. That is my reason for it. So far as hernia and recurrence of displacement are concerned, I will take the challenge from anybody. I do not wait on obstetric cases very much, but my assistants attend to this work largely in this city. From them and from practitioners outside, as well as from patients themselves, I am pretty well informed about the remote results in these cases. If anything serious

happens in connection with the operation I have done, I am quite sure to learn of it. There are no herniæ. A return of the displacement after this operation—there may be one case in two hundred, although I know of only two cases; and the percentage of recovery to health and comfort is equaled only by that glorious operation that I used to do — bi-inguinal celiotomy.

There were twelve years during which I made the *extended Alexander operation* fit nearly all the retroversions complicated with adhesions and diseased adnexæ (short of pus tubes). I liberated adhesions and resected or removed individual tubes and ovaries and shortened the round ligaments most ideally, through the simply dilated internal inguinal rings and canals.

In the hands of some twenty operators in America and Germany, about eight years ago, this procedure and other types of thoroughly modern Alexander operations counted nearly three hundred cases who had borne one or more children after their operation, with only about ten cases of recurrence of displacement. So crucial a fire of scrutiny and criticism all other retroversion operations together have never passed through. If retroversion were all that requires surgical treatment in the abdomen of women who have this disorder, then I would be doing this same bi-inguinal operation this day.

Dr. William M. Thompson: The last word on retrodeviations of the uterus has not yet been said. The real crux of Dr. Cuthbertson's paper, it seems to me, has been overlooked by the previous speakers, and that is the utilization of this tendon, or aponeurosis of the muscle; and the strong point in that is that it does not constrict the ligament. I think most of those men who draw up the ligament, tie it securely, and sometimes too securely, and in that way cut through the ligament, destroy its function, and the point made by Dr. Cuthbertson is that he deals with the utilization of this tendon or aponeurosis of the muscle for a suture.

Dr. N. S. Heaney: I have been following the Webster operation, which utilizes the uterine end of the round ligament. We have been very well satisfied with our results.

Dr. Polak recently published a paper in which his results following the Webster operation were not encouraging from our viewpoint, chiefly, we believe, because he performs it in a different way. Although those men who do the Gilliam operation have never seen strangulation of the gut, I who never have done this operation have seen strangulation of the intestine in two cases, one confirmed by autopsy and the other by operation, and I have heard of strangulation of the gut occurring in the practice of others. While I believe that the extreme outer end of the ligament theoretically is the better part to shorten up I don't believe that it is a matter of much practical importance and we expect to continue to use this method in the majority of our retroversion operations.

Dr. Mark T. Goldstine: As has been said by Dr. Heaney, you cannot pass upon an operation you have never done. The Webster-Baldy operation has been found satisfactory in the gynecological service at Wesley Hospital, and most of the general surgeons are using it, and Dr. Webster, Dr. Baldy, and Dr. Andrews are not responsible for every man's technique who tries to do that operation; so that if the uterus tips backward, they should not be criticised. A word about the Watkins-Wertheim operation: It is not primarily an operation for shortening the round ligaments by the vagina. Dr. Watkins shortens the round ligaments that way, but his operation is devised for extensive prolapse and cystocele, and not for shortening of the round ligaments. Furthermore, we are not of the opinion that shortening the round ligaments in correcting retroflexion will cure cystocele. We look upon cystocele as a hernia of the bladder, and by dealing with the ligaments and doing anterior colporrhaphy, you will get results. The Webster operation has been constantly successful with us, and is consistent with pregnancy. I have worked that part out and studied it carefully for Dr. Watkins, and we are satisfied with the results we get in pregnancy following the operation. Sometimes after shortening the round ligaments we advance the peritoneum of the bladder up to the top of the fundus of the uterus, and suture the broad ligament to the uterus where it comes through so that it is only a slight modification.

Dr. Chauncey W. Courtright: I feel that the Barrett operation, as he describes it, suits me better than any of the other methods with which I am familiar. I have seen many of these operations performed by different men, each with a little variation in technique, and yet, after all, it does not depend so much upon the strength of the round ligament as a great many would have us believe. However, I believe a mechanical principle obtains here as anywhere else; namely, if the uterus can be brought forward and held there, there is no reason why it should go back. If there are adhesions present they must be looked after. If the uterus is put in such a position that viscera will fall down behind it, there is no reason why it should require a hawser to hold the uterus

forward. I have heard it said to-night and emphasized that we should utilize the stronger portion of the round ligament. The question arises, Which is the stronger portion? Who has demonstrated it? Who has demonstrated which is the stronger portion of the muscle, the tendon, or the belly of the muscle? The fleshy part of the round ligament to my mind is more likely to give way than the tense fibrous part which is smaller, but fully as strong. In other surgical departments we look for a break in the muscle, not in its tendon, but in the belly of the muscle. I have had the biceps fracture in the middle, but never found a tendon fractured from traction or tension or pulling. I am not convinced that the stronger portion of the ligament is the more durable or permanent part of the round ligament, and that it is the only part to use in bringing the uterus forward and holding it there.

DR. LOUIS FISHMAN: We hear a good deal about the Gilliam operation and of strangulation of the intestine following it. Dr. Heaney said he knows of two cases of strangulation of the intestine following this operation, and there are other cases reported in the literature, although Gilliam himself denies this. He says that in all cases in which strangulation has taken place the round ligaments have run through abnormal or transperitoneal space. In order to overcome this defect, Dr. Barrett has devised his operation of bringing the round ligaments out through the abdominal ring, and his operation fulfills all the requirements of the Gilliam operation itself, and does away with the undesirable defect of dividing the peritoneal cavity. It produces a normal condition there in that the round ligaments should normally run outward, forward, and upward, while with the Gilliam operation they run forward, so that in the Barrett operation the uterus is supported by the round ligaments in a forward and outward direction.

Dr. Goldspohn has said that if we pull the uterus far enough forward we will overcome this defect. Personally, I have had no experience with the Gilliam operation, but I have had experience with the operation that Dr. Barrett has described in working with him and in my own work, and the results have been satisfactory. I have seen two cases in which the Gilliam operation was done, and the uterus was brought so far forward that both patients complained of extreme irritability of the bladder. Dr. Goldspohn spoke of the Webster operation fulfilling the requirements, and of patients going through pregnancy without any trouble, and the uterus remaining in position after labor. I have seen several of Dr. Barrett's patients who have gone through pregnancy and labor, as we have had the privilege of examining them subsequently, and we have found the uterus in its proper position. I have seen one case that has gone through two pregnancies, and the uterus has remained in good position. Personally, I have two cases that have gone through pregnancy, and the uterus is still in good position.

Dr. Heaney spoke of the weak and strong part of the round ligament. There is no question at all that the uterine end contains considerable muscle, and as we go out towards the internal ring the musculature disappears and becomes fibrous. Early in my medical career I learned that a scar is the weakest part in the body, and I still believe it, and the outer end of the round ligament is fibrous tissue, the same as a scar, and I should say would stretch much quicker than the belly of the muscle; so that while the Webster-Baldy operation or the Andrews-Webster-Baldy operation may give good results, it is the operation that utilizes the poor part of the ligament which is the better.

DR. FRANK W. LYNCH: There is a great similarity about these operations. In fact, no matter which one of the numerous operations you perform, there are successes and there are failures. It really seems that failures depend upon not how much we drag the uterus forward, but as to how we keep the cervix back at the same time we keep the uterus forward. I have known Kelly operations to be successful, and they are nothing but films of tissue and scar tissue. They do not do very much toward holding the uterus forward. It depends very largely upon the uterus which must be at the base of the broad ligament, and if we have a good pelvic floor, it does not make much difference what operation we do. I am a dissenter because I do not believe these displacements alone require much, if any, treatment. I do not believe we should operate upon these cases unless the uterus is enlarged or the patients have prolapsed ovaries or some thickening. Some of these patients do not complain of symptoms. I like to read papers by men who emphasize the point that the recurrences are frequent from practically any operation if we do not spare our sutures. We should all emphasize the fact that a pessary should be used, where there has been plastic work done, to keep tension off of the sutures.

DR. CHARLES E. PADDOCK: I am glad Dr. Lynch made the last remark. I have seen many cases following labor, when operation had been suggested for backward displacement of the

uterus, yet by supporting the uterus with a proper fitting pessary for a few weeks or months the operation was no longer indicated. It would be interesting to know from these gentlemen who find so many displacements calling for operation just what percentage had had similar treatment.

DR. LYNCH: I meant the use of pessaries after operations.

DR. CHANNING W. BARRETT: I thought this ground had been covered until the last speakers had talked. They have not struck the right operation. When a person gets up and says that all of these operations are alike, and that there are a number of cases in which recurrence of the retrodeviation has taken place, it is perfectly evident the right operation is not being done, because patients who undergo these operations are entitled to something better than that vague sort of thing. As regards the use of pessaries, I would say that an operation that is done properly for holding the uterus is not going to require the use of pessaries to hold that organ in position. Dr. Paddock is dealing with obstetric cases, and there are obstetric cases that have retrodisplacements which require a pessary or support to hold the uterus in proper position during the early weeks or months after confinement; and if the patient has a good pelvic floor, the practitioner will have success in keeping the uterus forward. On the other hand, in the gynecological cases where the retrodisplacement has gone on for months, the practitioner will not meet with success with any line of pessary treatment that can be carried out, because we have tried it and have failed.

DR. N. S. HEANEY: If Dr. Barrett has never seen a recurrence after his operation it is because he has not done a sufficient number of them, for if retroversion occurs occasionally in those who have previously been normal, what is to prevent its occasional recurrence after operation? Because a woman has a recurrence after labor is also not proof that the operation was not properly performed or was not the proper type of operation since we all know that a pregnancy causes most retroversions and displacements. It is not the fault of the operation, but it is a thing liable to happen after confinement, no matter whether the woman has had an operation or not.

DR. ALBERT GOLDSPOHN: I have made observations on what can be done with a pessary in the puerperal uterus, on a small number of cases. My conclusion so far is that if we take the average labor case (not the one where there has been severe infection), examine her two weeks postpartum, and on finding a retroversion, order her to assume the knee-chest posture two to three times daily for five to fifteen minutes, and to sleep in a Sims' position at night. A week later, the uterus having been secured in anteversion by the assistance of the knee-chest posture if necessary, fit a pessary large enough and of right shape to hold the uterus from turning over backwards again, and have the patient continue the posture treatment of herself, as before. In the meantime a doctor is able to correct a retroversion — bi-manually should examine the case from once a week to once a month, changing and introducing gradually smaller pessaries, so that the uterus is never permitted by its weight in retroversion to pull upon the idle recuperating round ligaments for about a year, then the case will be cured in a very high percentage of such attempts, — provided that the first six to eight weeks of this course of treatment occur before the physiological period for involution of the uterus and of its members — the round ligaments — is past; after that the cures by pessaries are possibly one or two per cent only.

DR. ROBERT T. GILLMORE: I think prophylaxis in connection with the question of retroversion of the uterus is an important factor, and I am surprised that obstetricians have not recognized the importance of posture in the prevention of retroposition. In the absence of complications of an inflammatory nature, it is well to have the patient lie on the stomach and use the knee-chest position, the sixth to the ninth day after labor. The uterus is usually so big that it will not drop back until after the sixth day. I have done that as a routine measure for the last ten years, and have had very few cases of retroflexion of the uterus after labor. In reference to the use of the pessary after labor, I do not think it should be used for at least five weeks, on account of the possibility of introducing infection.

The point brought up by Dr. Lynch in regard to keeping the cervix back in its normal position in the hollow of the sacrum is very important, and if it is back there we would not have so many retroflexions as we have. Of course, I am speaking now of gynecological retroflexions in which there are always symptoms of some complications that suggest some of the operations for the retroflexion. In other words, there are distinct indications for the use of the pessary; that these indications are clear to every gynecologist and I believe the pessary should be used more frequently than it is by gynecologists. I have had good results in cases of marked subinvolution of the uterus that had gone through labor, by a properly fitting pessary, and by keeping track of those

patients for some years, the uterus had remained in the correct position and the uterus was almost normal in size.

I do not believe in operating for retroflexion unless it produces symptoms or complications such as salpingitis or inflammation of ovaries, or fixation of the uterus backwards in which the adhesions have to be broken up. If there are no adhesions, so that the uterus can be put in normal position, we will get good results from the use of a pessary.

Dr. Louis Fishman: We hear of a good many cases of retroversion that occur shortly after labor that can be benefited by prophylactic measures, by non-operative means. I have seen a number of post-partum cases in Dr. Barrett's clinic that have been treated by the measures outlined here, the knee-chest position, and copious hot douches. There is one thing we have in these cases that has not been mentioned, and that is, we usually have subinvolution of the uterus and all the pelvic organs together with the ligaments of the uterus, and there is a decrease in the weight and size of the uterus by the hot douches and the use of glycerine and ichthyol tampons. If we proceed with these means for from four to six weeks, we can allow proper involution of the round ligaments by righting the uterus with a pessary. Dr. Gillmore raised the question of using a pessary in cases in which we have a freely movable uterus. We know that the uterus favors a malposition. If the malposition is not complicated by some pathologic condition, and produces practically no symptoms, it makes very little difference to the woman whether her uterus is in this or that position, but as a result of retroversion sooner or later there will develop pathology which will call for operative treatment. We know, as Dr. Goldspohn and others have said, a pessary will cure cases that have subinvolution of the uterus plus the pelvic tissues. On the other hand, a pessary will never cure cases that are chronic, that have gone two or three months past labor, because in those all the involution has taken place that will occur, and the pessary there acts as a mechanical agency; to hold the uterus in position we have to use it as long as the patient lives.

Dr. Frank W. Lynch: I fear I have been misunderstood in the use of pessaries. I meant to say, if I did not say so, pessaries after operation, and not after labor. I use a pessary in my cases for six or eight weeks after operation to take the strain off of the sutures.

Dr. William Cuthbertson (closing): I am sorry I did not read my paper. I am very glad Dr. Thompson called attention to the fact that the crux of my paper was in the method of anchoring the round ligament. Every man seems to be satisfied with the operation he does for the cure of retrodisplacements. I agree thoroughly with Dr. Barrett that up to the time I devised this modification the correct operation had not been done. I am very much pleased to hear men of wide experience, like Dr. Goldspohn and the majority of those who discussed my paper, agree that the use of the round ligament is the proper means of correcting these displacements. I will not attempt to reply to the individual discussants, but merely call attention to the fact that I do not anchor the round ligament to the aponeurosis of the external oblique, but I make use of a strip of the external oblique with which to support and fasten the round ligament in its new position. In regard to the trauma of this operation, I have used the Gilliam operation; I used to do ventrosuspension and ventrofixation, and I find that of all the extra-abdominal treatments of the round ligaments, the operation I have reported here causes as little trauma as any of the others in which the ligament is brought forward. Replying to the remarks of Dr. Lynch with regard to the support of the pelvic floor, I have stated in my report of the operation that where the pelvic floor is destroyed, I have repaired it, in order to give the uterus the added support which its natural structure affords it in a normal condition.

# BOOK REVIEWS

## A CRITIQUE OF NEW BOOKS IN SURGERY

By M. G. SEELIG, M. D., Saint Louis, Missouri

IN a recent issue of *The Nation*, Professor Hiram Bingham of Yale, writing of the late Adolph Alphonse Bandelier, the great American anthropologist, says, "It may have been due to his Swiss ancestry that his literary product seemed to combine German patience and thoroughness, with an originality and brilliance that is French." One wonders what added qualifications Professor Bingham would have attributed to an English strain in Bandelier's ancestry—possibly clarity of thought and force of expression. At all events it will be interesting to note in the books that lie on the table for review (and it happens, accidentally, that French, German, and English ones lie side by side) whether there is a characteristic national flavor as pronounced in type in the medical as in the literary products of these countries.

Der Chirurgische Kursus [1] by Schmieden, would be characterized by anyone as a typical German product, and largely for the reason that it mirrors patience and thoroughness. It is a volume intended solely for the teaching of operative surgery as an art separate and distinct from the science of surgery. There are four hundred pages, divided into eight sections, devoted respectively to ligation of arteries, resection of joints, amputations and exarticulations, operations on the extremities, operations on the head and neck, operations on the chest and trunk, abdominal operations, and operations on the urogenital system.

Written primarily for students, in their work on the cadaver, there is no call for citations from literature or extended discussions regarding the merit or demerit of various operative attacks. Indeed, one of the inherent excellencies of the book is the consummate care with which typical operative procedures are selected and described, step for step, with only those anatomical annotations necessary to the performance of intelligent work. One notes, however, with somewhat of a rude shock, that in describing the radical operation for carcinoma of the breast, Schmieden deliberately (both in his description and in his illustration) places the incision so that it runs directly through the axilla.

No small part of the value of the book resides in the four hundred and fifty-odd illustrations. The Germans of late have adopted a type of combined pencil, crayon, and wash-work illustration which, by the judicious admixture of a little red and brown color and the use of a semiglazed paper, produces a remarkably artistic effect without sacrificing clearness or detail. These very illustrations in themselves furnish evidence of the patient care and thoroughness that we have characterized as Teutonic. From this point of view the volume is an *exemplar*, even though it be not epochal.

NOW the French volume, [2] by way of contrast, mirrors in no sense of the word the brilliancy or originality attributed by Professor Bingham to French literary products. True, it deals with a subject that hardly permits of the display of either of these qualities, but nevertheless it awakens doubts in the minds of those who follow French medical literature of to-day as to whether or not there really exists anywhere in modern French medicine brilliancy and originality even approximating that displayed, let us say, by Charcot, Louis, or Pasteur (himself not a physician).

Lomon and Hahn have treated their subject in three parts. Part I is devoted to the armamentarium of the radiologist and in eleven chapters discusses the properties of the X-rays, the installation of apparatus, the various types of tube supports, tubes, examining tables, screens, intensifiers, and developers. This part of the book is carefully worked out, but, naturally, makes a stronger appeal to the technical röntgenologist than to the clinician.

Parts II and III are devoted entirely to the clinical side of radiology and discuss the interpretation of X-rays of bones and joints, the location of foreign bodies, the examination of the head, chest, and abdomen, and finally the therapeutic application of the X-ray. None of the contents of this second and third part of the volume furnishes new data. For the most part the material is well assembled, but there are omissions so weighty as to lessen the value of the entire work. No mention is made, for example, of ureter catheterization (with an opaque catheter) in locating ureter stones, and the very important subject of diseases of the duodenum is dismissed in four or five lines.

All in all, the book stands rather as an attempt to expound a knowledge of radiology in fairly full compass; but it misses out not only in that the expected French brilliancy and originality play no part in its

[1] Der Chirurgische Operations Kursus. Von Victor Schmieden; Dritte Auflage. Johann Barth, Leipsig, 1914.

[2] Précis de Radiologie Pratique. Par A. Lomon et C. Hahn. Société d' Éditions Scientifiques et Médicales. Paris, 1913.

composition, but also in that there is scanty evidence of the plodding thoroughness that we have learned to look for in good German productions.

THE English volume [1] is true to the English ideal. Although Walker specifically states in the preface that his object is to produce a textbook, his notion of a textbook is so broad —"a book that should reflect current opinion of the day and at the same time bear the impress of the experience and individual views of the author"— that he has succeeded in doing for genito-urinary surgery what Da Costa has done for general surgery with his textbook. When we say that Walker has maintained the English ideal, we mean that he has logically classified his data, carefully sifted it and then presented it with the clearness and force that practically always characterizes good English expository writing. The simple, clear English is reënforced by a wealth of severely plain illustrations that invariably illustrate.

The book is divided into eleven chapters. which discuss in order: kidney, ureter, bladder, urethra, prostate, seminal vessels and Cowper's glands, testicle, tunica vaginalis, spermatic cord, scrotum, and penis. Each subject is introduced with valuable anatomical considerations, important stress is laid upon pathological considerations, and then the etiology, clinical course, diagnosis, prognosis and treatment are described in a fashion that makes good the prefatory promise to outline the individual experience and views of the author. It is always refreshing to find an author saying, "I am opposed to such and such therapy," "I am opposed to" has not the ring of undesirable dogmatism, and it does whet the reader's curiosity both as to the basis for the opposition as well as to what alternate course the author pursues and advises.

As an evidence of Walker's special gift of presentation, we may cite his method of handling the subject of functional tests of the kidneys. In a scant five pages he discusses the subject in such fashion that he presents each functional test and establishes his notion of its practical value. Again, in the case of polycystic kidney, in four pages he furnishes a résumé of this complicated subject that is admirably concrete.

One notes with more or less surprise that under the head of pyelitis in children, the author advises alkalinization, or neutralization of the urine, as the best plan of treatment. This is in marked contrast with the ruling doctrine of the day that hexamethylenamine and an acid urine will practically always effect a cure. One is struck also by the firm stand taken by Walker against washings or instillations in tuberculous cystitis. He demonstrates his poise and judicial temper, however, by furnishing a list of various irrigations that may be used, and among them the five per cent carbolic solution so highly recommended some five years ago by Rovsing.

It is well nigh impossible to practice intensive critique on a volume covering so much ground, and treating so many discrete topics. If we recommend the volume as an almost necessary adjunct to a complete, working surgical library, suggest a bit more care in the next revision of the index and finally add that the author has maintained the English characteristics of conciseness, clearness, and force, we shall have stated fairly well our own opinion of the book.

THE prefatory semi-apologetic note which accompanies this volume of the Clinics [2] makes it very evident that, in all probability, both Dr. Murphy and his publishers are beginning to appreciate the generally expressed opinion that it is a herculean task for any one clinic to furnish adequate variety, in published form, every two months. There is possibly an intangible, yet nevertheless a very essential, difference between a clinic as published and as delivered from the pit; but as a matter of fact, even a listener would, in due course of time, surfeit on the steady diet of any one single clinician, however brilliant. Then, too, much of the attractiveness of the published clinics is marred by the form in which they are presented. A sentence such as "that is an entirely different course from that we have to follow" necessarily jars one's equanimity; and composure is not restored by encountering the phrase, "a fracture of both the internal and the external *malleoli*," in one line, and then, on the very next line, "a fracture of both the internal and the external *malleolus*. . . . is a dangerous case" (*sic*).

Yet, withal, the substance is solid. One can with difficulty find elsewhere a better discussion of Pott's fracture than the one published in this volume of the Clinics. It is interesting to note, in this connection, that Murphy persists in his radical advice to nail these malleolar as well as the condylar simple fractures, in spite of the strong protest voiced against these procedures in the surgical section at the last meeting of the American Medical Association.

The clinic on tuberculosis of the testicle is admirably full and satisfactory, and really constitutes about the only new topic in the volume. In this particular clinic Murphy makes the statement that sarcoma of the left testicle metastasizes by the blood route, in contra-distinction to sarcoma of the right testicle, which follows the lymph route. Such a statement should have been accompanied by the citation of authorities.

Dr. Murphy and his publishers promise variety next time, in the form of "a detailed talk on some special topic connected with the general subject of surgical diagnosis." This promise awakens keen anticipation.

[1] SURGICAL DISEASES AND INJURIES OF THE GENITO-URINARY ORGANS. By J. W. Thomson Walker, F. R. C. S., Cassell & Co., Ltd., London, New York, Toronto & Melbourne, 1914.

[2] The Clinics of John B. Murphy, M. D., at Mercy Hospital, Chicago. February, 1914. W. B. Saunders Co., Philadelphia & London.

IN its consistent attempt to correlate pharmacologic actions with physiologic functions the work of Meyer and Gottlieb [1] is unique among textbooks on pharmacology. As the authors state in the preface, they "have divided the drugs into two classes, organotropic (those influencing organs or their functions), and etiotropic (those acting on the causative agents of disease), and have thought it best to describe and analyze the organotropic pharmacological actions separately for each organ or function." The result is that instead of the stereotyped chapter headings of "Aconite," "Bromides," "Caffein," "Digitalis," or "Antipyretics," "Bitters," "Cathartics" "Diaphoretics," we find chapters devoted to the "Pharmacology of the Central Nervous System," "Pharmacology of the Digestion," "Pharmacology of the Circulation," "Pharmacology of the Eye," and so on. For example, the various actions of atropin and its congeners are not grouped together, but are to be found in the chapters on the central nervous system, vegetative nervous system, eye, digestion, circulation, respiratory system, and secretion of sweat. In the treatment of such a confusing subject as pharmacology this method seems ideal, and it has been consistently followed throughout.

The authors have added much to the value of the book by prefacing each chapter with an epitome of the physiology of the function under discussion. These summaries are particularly lucid in the chapters on the vegetative nervous system, circulation, and renal function.

Much work has been done within recent years to determine the extent to which the chemical constitution of a given drug affects its pharmacologic action. Evidences of this are seen throughout the book, perhaps being nowhere more clearly brought out than in the discussion of cocain and its synthetic substitutes.

[1] PHARMACOLOGY CLINICAL AND EXPERIMENTAL. A Groundwork of Medical Treatment, being a Textbook for Students and Physicians, by Dr. Hans H. Meyer, of Vienna, and Dr. R. Gottlieb, of Heidelberg. Authorized Translation into English by John Taylor Halsey, M. D. Philadelphia and London: J. B. Lippincott Company, 1914.

The treatment of such entirely practical subjects as anæsthetics, management of circulatory failure, and diuretics is admirable. There is a thorough presentation of the experimental facts and theories of digitalis action; but this is unfortunately not balanced by a discussion of digitalis therapy in the various clinical aspects of diseases of the heart.

The chapter on "Etiotropic Pharmacological Agents" includes Antiseptics; Anthelmintics; Creosote in Tuberculosis; Quinine in Malaria; Salicylates in Rheumatism; Arsenical Compounds in Protozoal Diseases; Mercury in Syphilis; Tuberculin and Serum Therapy.

In the last chapter on "Factors Influencing Pharmacological Reactions" we find an able discussion of important topics such as Relation between Size of Dosage and Intensity of Effect; Functional Condition of the Organs; Antagonism; Disintoxication; Immunity; Synergism; Hypersusceptibility and Anaphylaxis.

The full index to the volume precludes any criticism of the method of presenting in connection with the various bodily functions the facts concerning a given pharmacologic agent, even though this scatters the facts throughout several chapters.

There seems to be too much of a tendency on the part of the authors to accept without comment the unconfirmed statements of investigators relative to certain drug effects; but this is in many cases corrected by the terse, subjoined notes of the translator, who has here and elsewhere throughout the volume inserted remarks of much practical value. The translator, furthermore, deserves much credit for the evident care with which his part of the work has been carried out.

This book should prove of greatest value to the scientific, thinking physician, who is well grounded in normal and pathologic physiology, and whose experience should prevent his too ready acceptance of of statements of experimental observations or of their reputed clinical significance. The value of the book is further enhanced by a bibliography appended to each subject.

## BOOKS RECEIVED

Books received are acknowledged in this department, and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

A SYSTEM OF SURGERY. Edited by C. C. Choyce, B. Sc., M. D., F. R. C. S.; and J. Martin Beattie, M. A., M. D., C. M. Three volumes. Price $7.00 per volume. New York City: Funk & Wagnalls Company, 1914.

SURGERY, ITS PRINCIPLES AND PRACTICE. By Astley Paston Cooper Ashhurst, A. B., M. D., F. A. C. S. Philadelphia and New York: Lea & Febiger, 1914.

A HISTORY OF LARYNGOLOGY AND RHINOLOGY. By Jonathan Weight, M. D. Philadelphia and New York: Lea & Febiger, 1914.

A MIND REMEDY. By John G. Ryerson, M. D. Published by the author.

DE LA NEPHROPEXIE. (Procédé d'Albarran-Marion.) Par le Dr. Jules Luzoir. Paris: G. Steinheil, Editeur; 1913.

PAIN. Its Origin, Conduction, Perception and Diagnostic Significance. By Richard J. Behan, M. D. New York and London: A. Appleton and Company, 1914.

NASAL ACCESSORY SINUSES. Development and Anatomy of the Nasal Accessory Sinuses in Man. By Warren B. Davis, M. D. Price $3.50 net. Philadelphia and London: W. B. Saunders Company, 1914.

THE PRACTICE OF PEDIATRICS. By Charles Gilmore Kerley, M. D. Price, $6.00 net. Philadelphia and London: W. B. Saunders Company, 1914.